JLG® GRADALL®

SERVICE MANUAL

GRADALL®

534C-9
534C-10

2460-4129

July 2002

534C-9 Starting S/N
0344394 thru 0444002

534C-10 Starting S/N
0266057 thru 0266106

CORPORATE OFFICE

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JLG® GRADALL®

OWNER/OPERATOR MANUAL

GRADALL®

534C-9
534C-10

2460-4171

July 2002

534C-9 Starting
S/N 0344394

534C-10 Starting
S/N 0266057

Form #20042 Original Issue 3/01

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GRADALL®

MATERIAL HANDLERS

534C-9/534C-10 MATERIAL HANDLER OPERATION & LUBRICATION MANUAL

IMPORTANT!

Read and understand this manual, the Gradall Material Handler Safety Manual and the EMI Rough Terrain Forklift Safety Manual before starting, operating or performing maintenance procedures on this machine.

KEEP THESE MANUALS IN CAB

AVERTISSEMENT! Si vous ne lisez pas l'Anglais, demandez a votre surveillant de vous donner les instructions de securite!

ATENCION! Si no lee Ingles, preguntele a su supervisor para las instricciones de seguridad!

VORSICHT! Wen Sie kein Enlisch lesen, bitten Sie ihren Vorgesetzten um die Sicherheitsvorschriften!

Gradall is a registered trademark for hydraulic excavators, hydraulic material handlers and attachments manufactured by the Gradall Co.

Covers 534C-9 Units Starting Serial No. 0344394
AND
Covers 534C-10 Units Starting Serial No. 0266057

Form No. 20042
Original Issue 3/01

Part No. 2460-4171

IMPORTANT SAFETY NOTICE

Safe operation depends on reliable equipment and proper operating procedures. Performing the checks and services described in this Manual will help to keep your GRADALL Material Handler in reliable condition. Following recommended operating procedures can help you avoid accidents. Because some procedures may be new to even the experienced operator, we require that this Manual be read, understood and complied with by all who operate this machine.

Strict attention to and compliance with instructions provided in this Manual, the EMI Rough-Terrain Forklift Safety Manual, the GRADALL Material Handler Safety Manual, the GRADALL/EMI Operator Orientation Video, as well as instructional decals and plates affixed to the machine will help prevent injuries to personnel and damage to the equipment. The information provided herein is not intended to cover all situations; it is impossible to anticipate and evaluate all possible applications and methods of operation for this equipment.

This Manual covers recommended operating procedures and basic maintenance checks and services for the 534C-9 & 534C-10 Material Handler. Detailed maintenance information is available in the appropriate Service Manual.

Any procedure not specifically recommended by GRADALL must be thoroughly evaluated from the standpoint of safety before it is placed in practice. If you are not sure, contact your GRADALL Material Handler Distributor before operating.

Use only GRADALL-authorized parts. The use of counterfeit parts may cause premature failure which could lead to injuries and/or machine damage.

Do not modify this machine without written permission from GRADALL. Use only genuine GRADALL replacement parts.

OTHER NOTICES

GRADALL retains all proprietary rights to the information contained in this Manual.

GRADALL reserves the right to change specifications without notice.

GRADALL is a registered trademark for Hydraulic Excavators, Hydraulic Material Handlers and Attachments manufactured by The Gradall Company.

Form No. 20042 - Original Issue 3/01

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INTRODUCTION

General

This manual provides important information to familiarize you with safe operating procedures and operator maintenance requirements for the Gradall 534C-9 and 534C-10 Material Handlers.

If you have any questions regarding the material handler, contact your Gradall Material Handler Distributor.

Operator Qualifications

Operators of the material handler must be in good physical and mental condition, have normal reflexes and reaction time, good vision and depth perception and normal hearing. He/she* must not be using medication which could impair his abilities nor be under the influence of alcohol or any other drug during the work shift.

The operator should also possess a valid, applicable driver's license and must have completed a course of training in the safe operation of this type of material handling equipment.

In addition, the operator must read, understand and comply with instructions contained in the following material furnished with the material handler:

- This Operator's Manual
- EMI Rough Terrain Forklift Safety Manual
- Gradall Material Handler Safety Manual
- Gradall/EMI Operator Orientation Video
- All instruction decals & plates
- Any optional equipment instructions furnished

The operator must also read, understand and comply with all applicable Employer, Industry and Governmental rules, standards and regulations.

Regardless of previous experience operating similar equipment, the operator must be given sufficient opportunity to practice with the Material Handler in a safe, open area (not hazardous to people or property) to develop the operating skills and the proper "feel" for controls and operating clearances required for safe, efficient operation.

*Though no offense or discrimination is intended, only the masculine pronouns will be used throughout the remainder of this manual.

Orientation

When used to describe location of components in the material handler, the directions front, rear, right and left relate to the orientation of a person sitting in the operator's seat.

Related Manuals & Decals

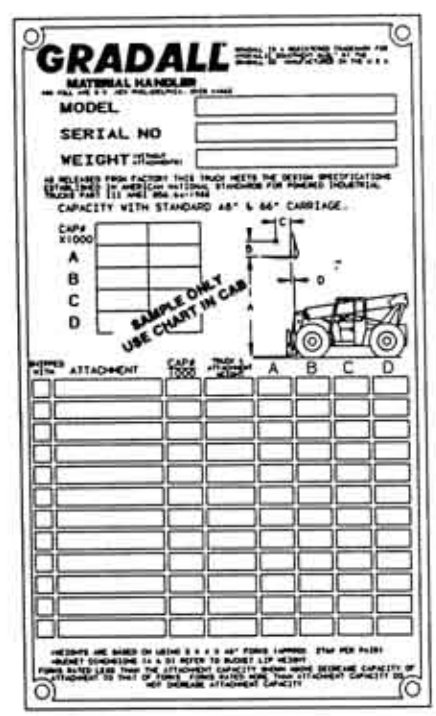
Separate publications are furnished with the material handler to provide information concerning safety, replacement parts, maintenance procedures, theory of operation and vendor components. Replacement manuals, decals and instruction plates can be ordered from your Gradall Material Handler Distributor.

Models Covered

This manual covers the 534C-9 and 534C-10 Material Handlers. 534C-9 units are furnished without outriggers and 534C-10 units are furnished with outriggers. Both units are equipped with three section booms and four wheel drive. Optional equipment available for use with these units is described in appropriate sections of this manual.. Be certain to refer to proper information for your unit.

Serial Number Location

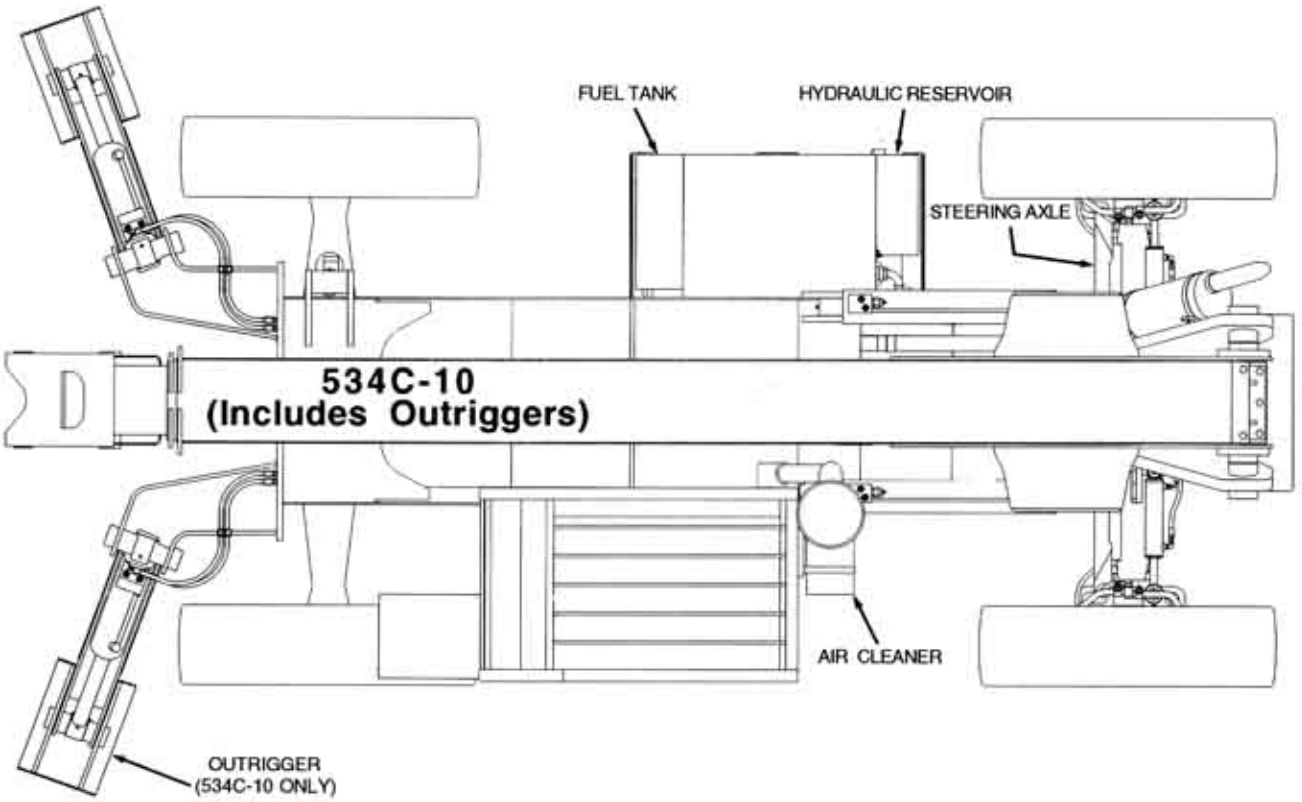
Specify Model and Serial Numbers when ordering parts and when discussing specific applications and procedures with your distributor. The model/serial number plate is located on the cab wall to the right of the operator's seat.

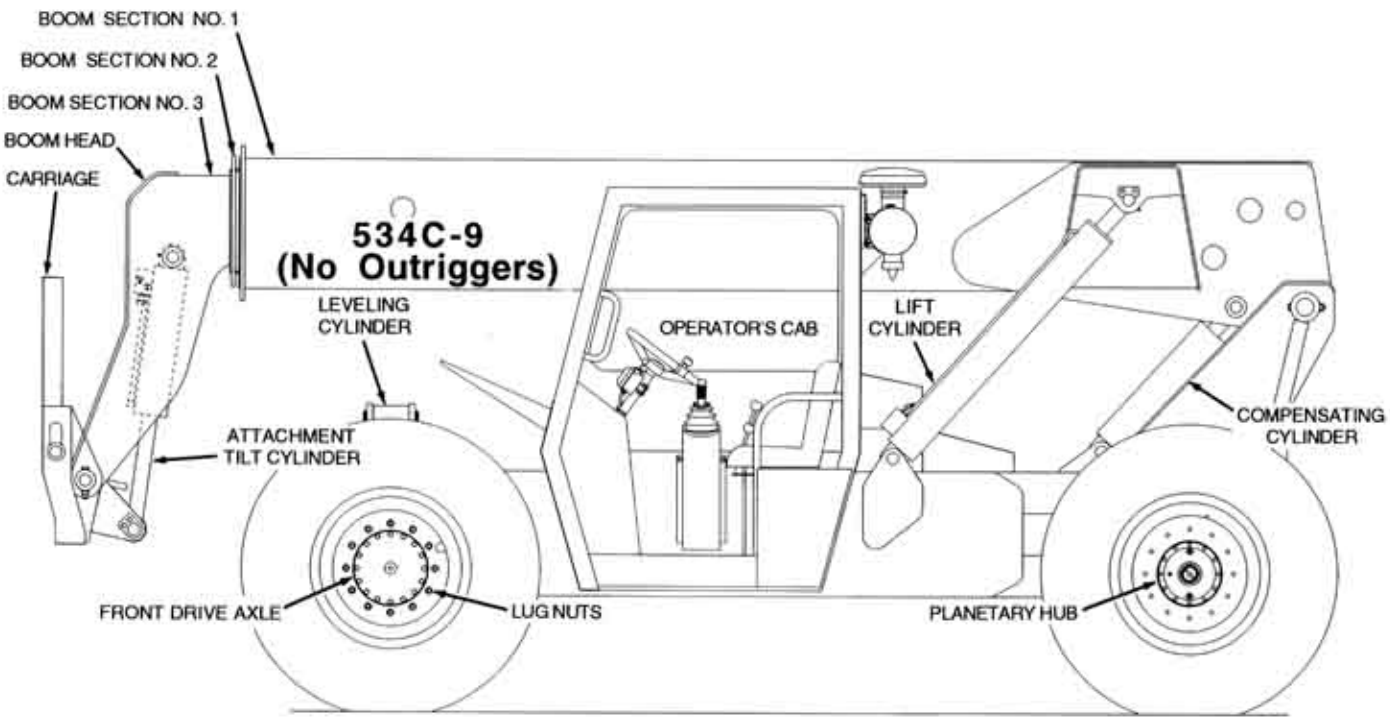


Nomenclature

The illustrations on page 3 include nomenclature applied to major components of the material handler. The term "handler" will be used throughout the balance of this manual in place of the words "material handler".

Nomenclature





SAFETY HIGHLIGHTS

Read and understand all manuals and instructional material listed on cover, inside front cover and page 2 of this manual before starting, operating or performing maintenance procedures on this equipment.

Safety information in this manual is specific to models covered. Other publications listed describe general safety precautions relating to material handling.

Operators of this equipment must have successfully completed a training program in the safe operation of this type of material handling equipment.

Regardless of previous experience operating similar equipment, the operator must be given sufficient opportunity to practice with the handler in a safe, open area (not hazardous to people or property) to gain operating skills and proper "feel" for controls and operating clearances required for safe efficient operation.

The Gradall Material Handler is equipped with a right-side rear view mirror. This mirror is intended as an operator's aid and does not replace the requirement for line of sight. Certain jobsite and machine conditions may require use of a signal person to help operator when picking, placing or transporting a load. Never operate the handler until you know pick-up point, line of travel and landing point are clear. Always be aware that objects in mirror are closer than they appear.

Watch for these symbols; they call your attention to safety notices

⚠ DANGER

This symbol indicates an extreme hazard which would result in high probability of death or serious injury if proper precautions are not taken.

⚠ WARNING

This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.

⚠ CAUTION

This symbol indicates a hazard which could result in injury or damage to equipment or property if proper precautions are not taken.

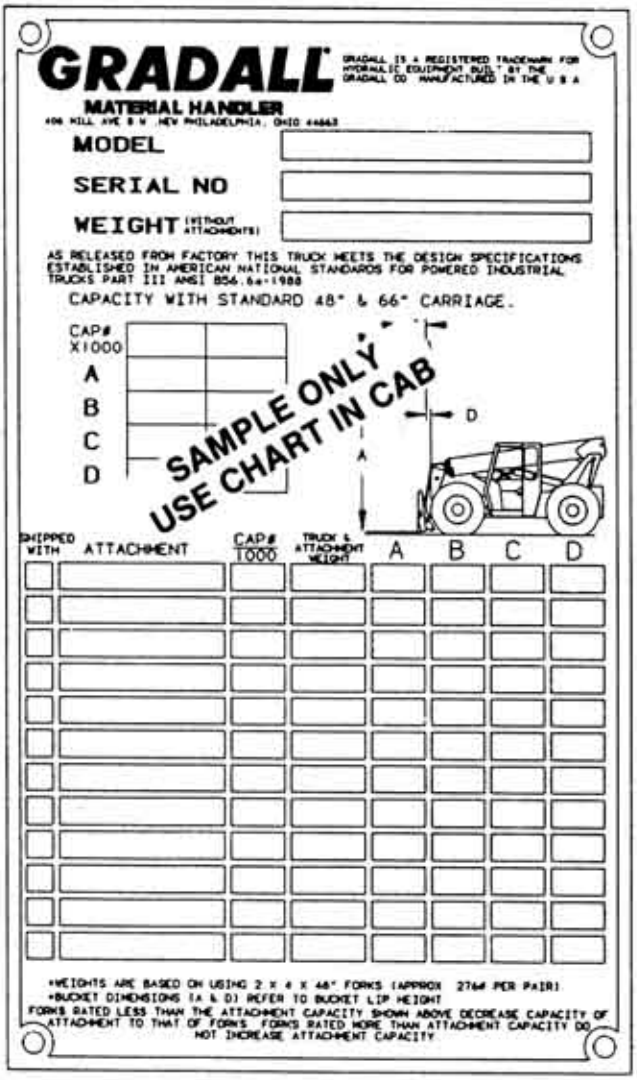
Safety Precautions

⚠ WARNING

Operator must be seated with seat belt fastened, forward reverse lever in neutral position, parking brake applied and all hydraulic controls in neutral position before starting engine.

- Check to be sure all **DANGER, WARNING, CAUTION** and **INSTRUCTION DECALS** are in place and can be read. Clean or replace decals as required.
- Be certain forklift is on a firm, level surface before lifting or placing load. Have surface leveled if necessary. **Unit can tip over if load is raised with forklift on a soft or uneven surface.**
- Always look in the direction of travel. **Reduce speed and be especially careful when traveling in reverse and/or turning.**
- If load or conditions obstruct view, **use a signal person** when lifting, carrying or placing a load.
- Loose clothing can get caught in moving machinery and can also cause accidental actuation of controls. **Dress properly for the job.**
- **Be alert for any unusual response to controls.** If unusual response is noticed, position unit in a safe area if possible, lower forks to rest, apply parking brake, stop engine and remove key from ignition switch. Tag steering wheel to forbid operation and **notify maintenance personnel.**
- Keep hands, gloves, shoes, control knobs and pedals clean. **Slippery controls can cause accidents.** Keep a firm grip on steering wheel when traveling.
- **Load capacities are based on load center being within 24 inches from front vertical face of forks.**
- **Never service unit with engine running.**
- **Release trapped pressure** before disconnecting, opening or removing any hydraulic component.
- **Whenever leaving cab,** position unit in a safe location, apply parking brake, lower forks to ground, move all controls to neutral, stop engine and remove key from ignition. Chock wheels if parking on a slope.
- **Never permit diesel engine to run out of fuel.** Doing so can cause severe damage.

Decals



Located on Right Cab Wall
534C-9 Part No. 9114-3150
534C-10 Part No. 9115-3003

HYDRAULIC OIL

7702-3006

Located on Hydraulic Tank
Part No. 7702-3006

IMPORTANT
To prevent damage to the electrical system when using booster battery or charger, always connect
(+) POSITIVE TO POSITIVE
(–) NEGATIVE TO NEGATIVE

Located on Battery Cover
Part No. 7702-3007

WARNING

TO PREVENT INJURY, KEEP OUT OF BOOM HOLES.

7702-3009

Located on Both Sides of Boom
Part No. 7702-3009

DO NOT ENGAGE PARK BRAKE WHILE MACHINE IS IN MOTION - STATIC BRAKE ONLY

Located on Instrument Console
Part No. 9114-3182

DANGER

DEATH OR INJURY MAY RESULT FROM CONTACTING ELECTRICAL LINES.

UNLAWFUL TO PLACE ANY PART OF THIS MACHINE OR LOAD WITHIN 10 FEET OF HIGH VOLTAGE LINES OF UP TO 50,000 VOLTS.

FOR MINIMUM CLEARANCES OF HIGH VOLTAGE LINES IN EXCESS OF 50,000 VOLTS, SEE YOUR LOCAL, STATE AND FEDERAL REGULATIONS. DO NOT DEFACE OR REMOVE THIS SIGN FROM THIS MACHINE

Located on Mud Guard
Part No. 8360-1011

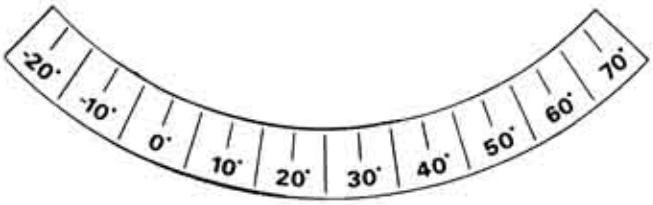
WARNING

FUEL - DIESEL
EXTINGUISH ALL OPEN FLAME AND SMOKING MATERIALS WHEN REFUELING.

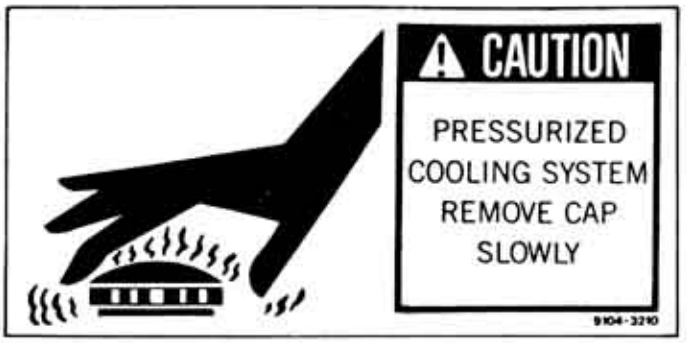
9100-3052

Located on Fuel Tank
Part No. 9100-3052

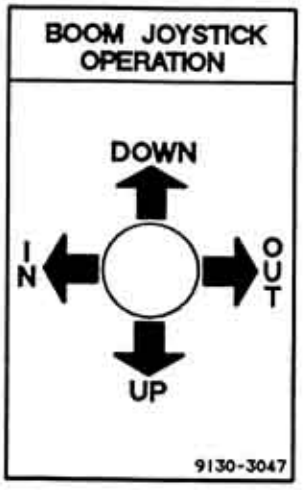
Decals



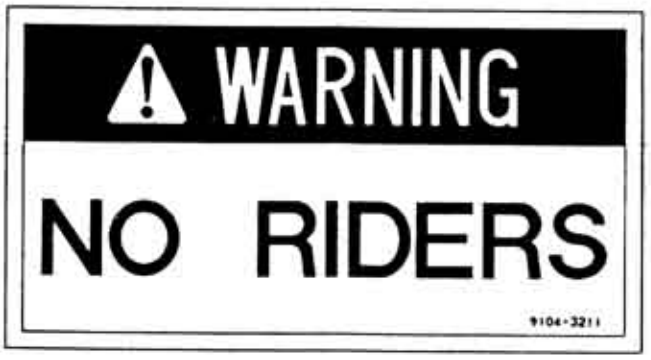
Located on Side of Boom
Part No. 9100-3031



Located on Engine Cover
Part No. 9104-3210



Located on Joystick Pedestal
Part No. 9130-3047 (Std.)



Located Outside Cab
Part No. 9104-3211

Located on Engine Compartment
Part No. 9103- 3011

Located on Engine Compartment
Part No. 7734-3018

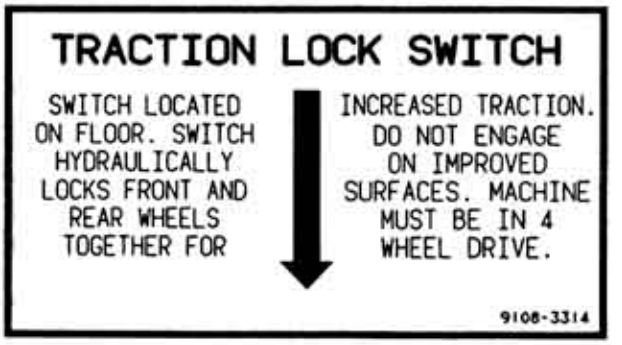
Located on Right & Left Rear Frame
Part No. 9104-3209

Located on mud guard
Part No. 9055-3027

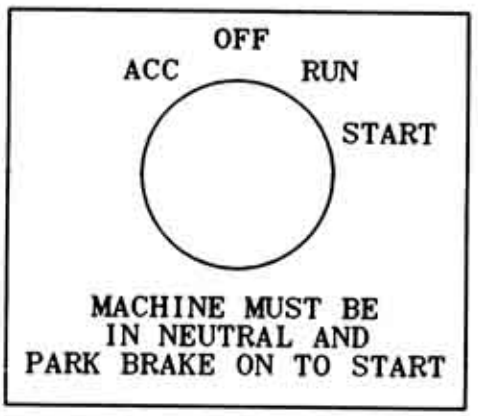
Decals

Located on right side of cab wall and instrument panel
Part No. 9055-3028

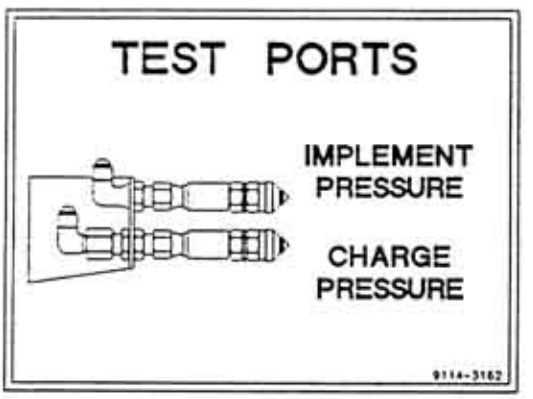
Located on Forward/Reverse Switch
Part No. 9108-3428



Located on Instrument Console
Part No. 9108-3314



Located on Instrument Console
Part No. 9114-3120



Located on Hyd. Reservoir Cover
Part No. 9114-3162

Located on Lever Knob
Part No. 9108-3318

Located on Lever Knob
Part No. 9108-3317

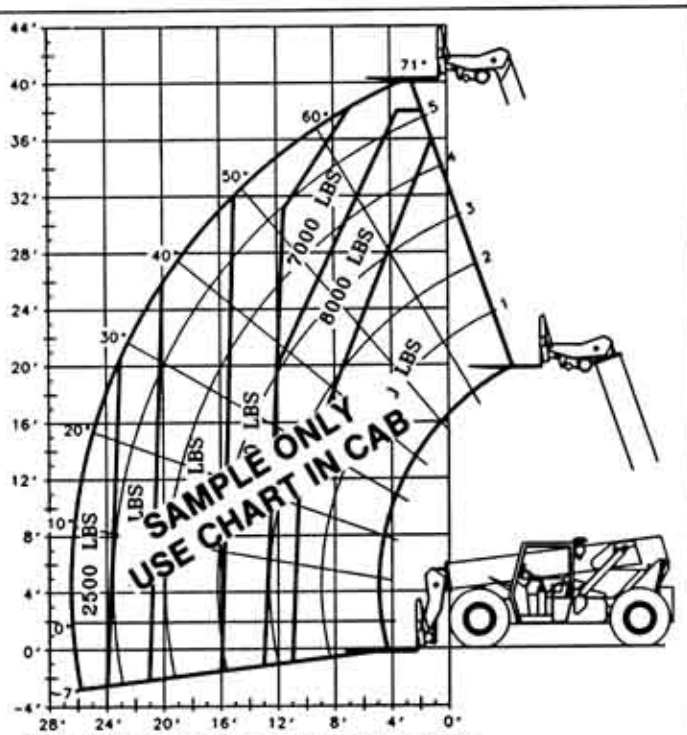
Decals

CAPACITY CHART
MODEL 534C-9
RATED CAPACITY @ 2 FT LOAD CENTER

USE WITH:

9045-5051	48" CARRIAGE
9045-5052	66" CARRIAGE
9055-5008	72" CARRIAGE
9112-5022	INSTANT HOOK (3000# MAX. CAP.)

FOR OTHER ATTACHMENTS CONSULT A GRADALL DEALER FOR LOAD RATINGS.
USE LARGEST NUMBER VISIBLE FROM THE CAB TO DETERMINE BOOM EXTENSION. MATCH WITH BOOM ANGLE TO DETERMINE ALLOWABLE LOAD.



BOOM EXTENSION IN FEET FROM TIRE TO LOAD CENTER (24" IN FRONT OF FORK FACE).

FIGURES SHOWN ARE STACKING CAPACITY TRUCK LEVEL.
RATED LIFTING CAPACITIES SHOWN ARE WITH MACHINE ON A FIRM, LEVEL SURFACE WITH UNDAMAGED, PROPERLY INFLATED TIRES.
MACHINE SPECIFICATIONS AND STABILITY ARE BASED ON RATED LIFT CAPACITIES AT SPECIFIC BOOM ANGLES AND BOOM LENGTHS.
IF SPECIFICATIONS ARE CRITICAL, THE PROPOSED APPLICATION SHOULD BE DISCUSSED WITH YOUR DEALER.
DO NOT EXCEED RATED LIFT CAPACITY LOADS, AS UNSTABLE AND DANGEROUS MACHINE CONDITIONS WILL RESULT.
DO NOT TIP THE MACHINE FORWARD TO DETERMINE ALLOWABLE LOAD.
CAPACITY LIMITS FOR THIS UNIT ARE BASED IN ACCORDANCE WITH ASME B56.6a - 1994
LEVEL GRADALL HANDLER BEFORE LIFTING ABOVE 4 FT.

9114-3151

Located on Instrument Console
534C-9 Part No. 9114-3151
534C-10 Part No. 9115-3002

⚠ WARNING

READ AND UNDERSTAND THE FOLLOWING PRIOR TO LIFTING PERSONNEL.
WHEN LIFTING PERSONNEL USE ONLY A GRADALL MANUFACTURED PERSONNEL WORK PLATFORM.
ALL PERSONNEL IN PLATFORM MUST WEAR A FULL BODY HARNESS WITH LANYARD ATTACHED TO A DESIGNATED ANCHORAGE POINT.
READ AND UNDERSTAND PERSONNEL WORK PLATFORM USER'S MANUAL BEFORE OCCUPYING PERSONNEL WORK PLATFORM.
FAILURE TO COMPLY COULD RESULT IN SERIOUS INJURY OR DEATH.

9055-3026 REV A

Located on boom head and personnel work platform
Part No. 9055-3026

⚠ WARNING

CHECK TO ASSURE QUICK SWITCH PIN IS FULLY ENGAGED AND LOCKED AFTER ATTACHMENT CHANGE.

2-9103-3023

Located on Boom Head
Part No. 9103-3023

GRADALL HANDLER
SERVICE INSTRUCTIONS
FOR: 534C-10

SERVICE INTERVALS

	DAILY OR 10 HRS	WEEKLY OR 50 HRS	EVERY 3 MOS OR 250 HRS	6 MO. OR 500 HRS	1 YR. OR 1000 HRS	ANNUALLY OR 1500 HRS	TYPE OR EQUIVALENT
DIESEL AIR FILTER				CHANGE			
FUEL FILTER			CHANGE				
OIL	CHECK FILL		CHANGE				SAE 15W-40-CD +++ DIESEL FUEL #2
HYD. OIL FILTER	CK			INSPECT		CHANGE CHANGE	ISO GRADE 46 OR EQUAL
HYD. TANK			CHECK		CHANGE		
FRONT AXLE (4 CAL 1 PT)			CHECK		CHANGE		MOBIL 424
REAR AXLE WHEEL			CHECK		CHANGE		GL-5 80-90
WHEEL NUT TORQUE				TORQUE			
BATTERY & TERMINALS							
RADIATOR 3 GAL. WATER 3 GAL. ANTI-FREEZE							ETHYLENE GLYCOL ANTI-FREEZE
TIRES: 13.00x24 (12 PLY)							
TIRES: 14.00x24 (14 PLY) 60							
TIRES: RADIAL 70 PSI							
CYLINDER FITTINGS EACH END							EP 2 M-152
REAR AXLE (12) FITTINGS							EP 2 M-152
FRONT AXLE PIVOT (2) FITTINGS							EP 2 M-152
ALL BEARINGS PADS							EP 2 M-152
FRONT BOTTOM BEARING PADS							EP 2 M-152
BOOM PIVOT (2) FITTINGS			GREASE				EP 2 M-152
HEAD PIN (2) FITTINGS			GREASE				EP 2 M-152
BOOM SHEAVES (3) FITTINGS			GREASE				EP 2 M-152
QUICK SWITCH (1) FITTING			GREASE				EP 2 M-152
RETRACT & EXTEND CABLE SEE OPERATOR & MAINTENANCE MANUAL							

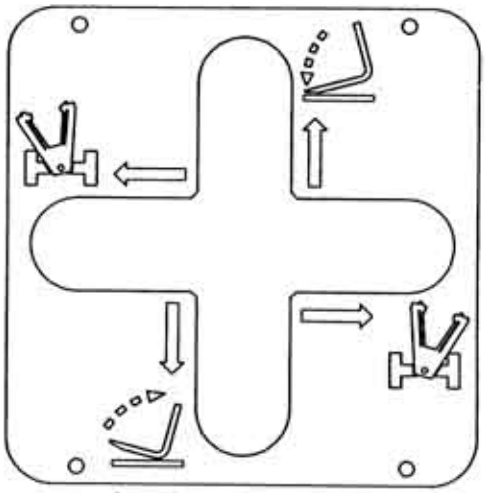
THIS CHART MUST BE USED IN CONJUNCTION WITH SERVICE
* CHECK INDICATOR ON HYDRAULIC FILTER. CHANGE FI AT FULL THROTTLE & AT OPERATING TEMPERATURE.
** CHECK AIR CLEANER RESTRICTION INDICATOR. CLEAN OR CHANG
*** CONSULT DEALER FOR RECOMMENDATIONS AT EXTREME TEMPERATURE
**** DAILY SERVICE MAY BE REQUIRED FOR OPTIMUM LIFE DEPENDING U SEVERITY.
IT IS RECOMMENDED THAT FILTER ELEMENTS AND FRONT AXLE LUBRICANT D AFTER FIRST 50 HRS ON NEW OR REBUILT UNITS.

9114-3219

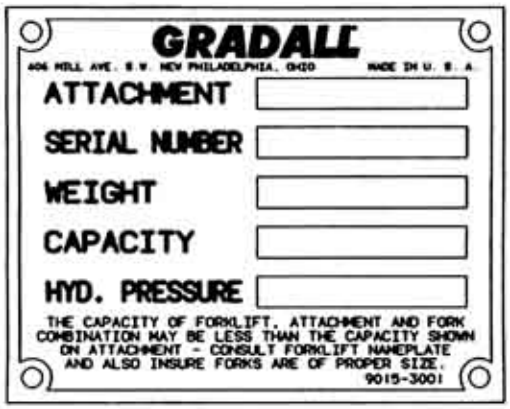
SAMPLE
Refer to Lubrication Section of this Manual

Located on Mud Guard
Part No. 9114-3219

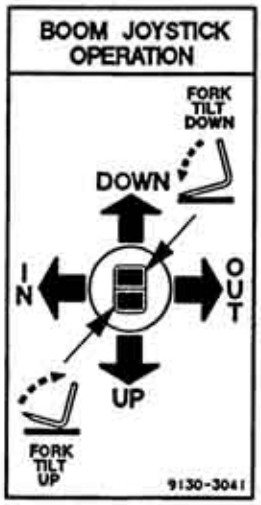
Optional Equipment Decals



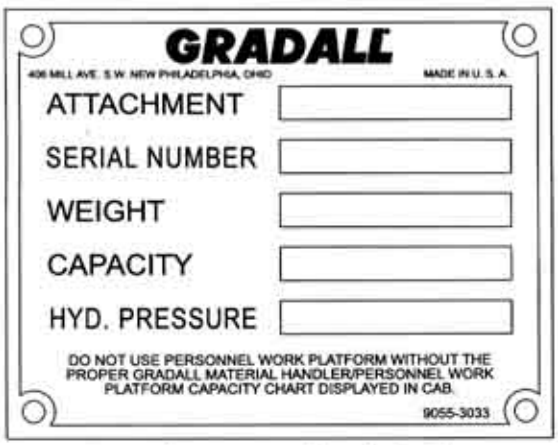
Located on Instrument Console
Part No. 9108-3341



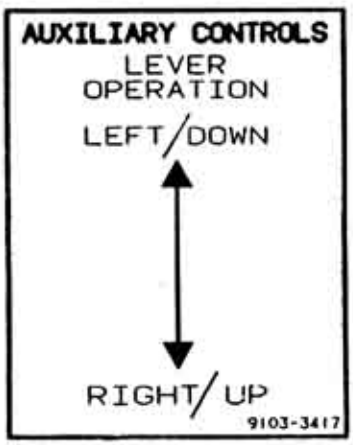
Located on Attachment
Part No. 9015-3001



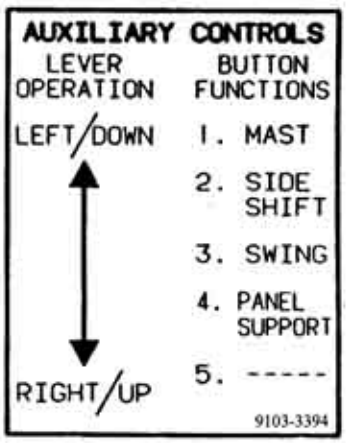
Located on Joystick Pedestal
Part No. 9130-3041



Located on personnel work platform
Part No. 9055-3033



Located on Instrument Console
Part No. 9108-4210



Located on instrument console
Part No. 9103-3394

Located on personnel work platform
Part No. 9055-3032

Located on personnel work platform
Part No. 9055-3031

OPERATOR'S CAB

The standard cab permits vision from all sides and includes an overhead guard to provide protection from falling objects.

⚠ WARNING

Never operate the handler unless the overhead guard is in place and in good condition.

A fully enclosed cab with windows and a lockable door is available as an option. The cab door can be secured in the fully opened or closed position. Be sure the door is fully secured when operating the handler.

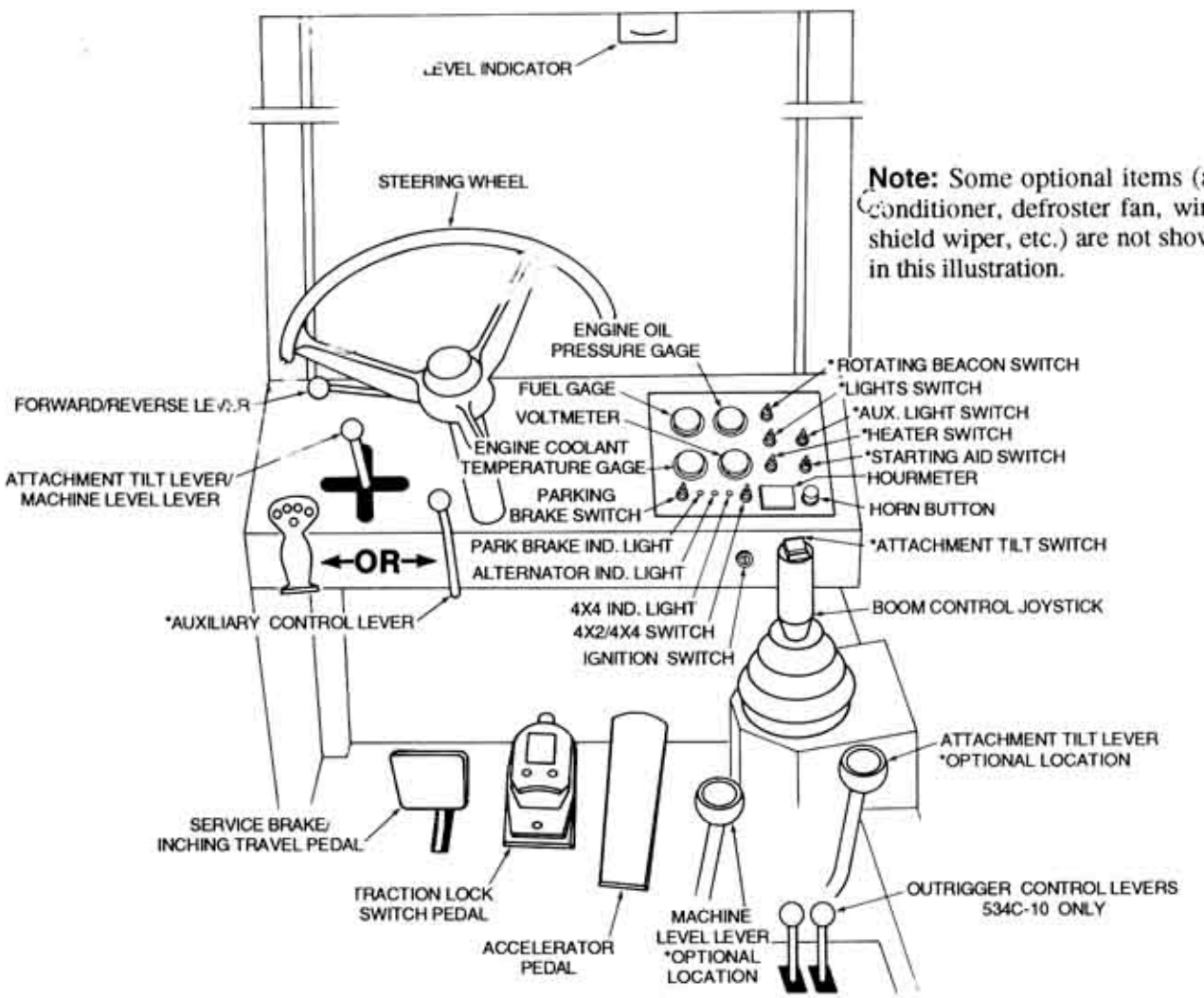
The operator's seat is equipped with a seat belt and includes fore and aft adjustment to compensate for variations in operator size. The adjustment release/lock is located beneath front edge of seat. **Wear seat belt when operating machine.**

An optional windshield wiper is available for use with enclosed cabs. An ON/OFF control switch is located on the wiper motor.

A variable speed defroster fan is available for use with enclosed cabs. An ON/OFF control switch and speed control are located on the base of the fan.

A variable speed heater fan is available for use with units equipped with a heater. An ON/OFF/SPEED CONTROL knob is located on the dashboard. Hot water to the heater can be controlled by a valve at the engine.

CONTROL AND INSTRUMENT IDENTIFICATION



Note: Some optional items (air conditioner, defroster fan, windshield wiper, etc.) are not shown in this illustration.

***ITEMS PRECEDED BY AN ASTERISK ARE OPTIONAL AND MAY NOT BE FURNISHED ON YOUR HANDLER.**

⚠ WARNING

A brief description of controls and instruments is provided here as a convenience for the operator. These descriptions DO NOT provide complete operating instructions. Read and understand this manual, the EMI Rough Terrain Forklift Safety Manual and the Gradall Material Handler Safety Manual.

NOTE: These descriptions are provided in alphabetical sequence in accordance with the nomenclature shown on the facing page.

Accelerator Pedal: The accelerator pedal is connected to the engine speed control by a cable to provide accurate engine speed control. Depress pedal to increase speed and release pedal to decrease speed.

Alternator Indicator Light: Glows (red) to indicate alternator is not charging.

Attachment Tilt Lever (Std.): This lever controls tilt of the fork carriage. Speed is proportional to lever actuation. Push lever forward to tilt down or pull lever to rear to tilt up.

Attachment Tilt Switch (optional): Depress front of switch to tilt down or depress rear of switch to tilt up.

Auxiliary Control Lever (optional): This lever is used to control optional hydraulic attachments. Follow decal instructions for lever/handler movements.

Auxiliary Light Switch: This switch turns auxiliary lights on and off.

Boom Control Joystick: This joystick controls boom elevation and extension. Pull joystick to rear to raise boom or push forward to lower boom. Move joystick to right to extend boom or move to left to retract boom. Speed of boom movement is proportional to joystick actuation and engine RPM.

Engine Coolant Temperature Gage: This gage displays engine coolant temperature.

Engine Oil Pressure Gage: This gage displays engine oil pressure.

Forward/Reverse Lever: This lever engages forward or reverse travel. Push lever fully forward for forward travel; pull lever fully to rear for reverse travel or move lever to centered position for neutral.

Fuel Gage: This gage displays level of fuel in fuel tank.

Heater Fan Switch (optional): This rotary switch controls heater fan. Rotate clockwise to start fan. Continued clockwise rotation controls fan speed.

Horn Button: Depress button to sound horn.

Hourmeter: This meter indicates total time of engine operation in hours and tenths of hours.

Ignition Switch: This switch is actuated by a key. In ON position (turned clockwise) voltage is available for all electrical functions. Full clockwise rotation engages starter motor. Turn key counterclockwise to stop engine and remove voltage from all electrical functions.

Level indicator: This indicator (a bubble level) enables the operator to determine the left to right level condition of the handler.

Lights Switch (optional): This switch controls optional lighting which may be provided with the handler.

Machine Level Lever (Std.): This lever controls the relationship of the handler frame to the front axle. Move the lever to left to tilt frame to left or move lever to right to tilt frame to right.

Outrigger Control Levers (534C-10 only): Left lever controls left outrigger and right lever controls right outrigger. Push levers forward to lower outriggers or pull levers to rear to raise outriggers.

Parking Brake Switch: This switch controls the application and release of the parking brake.

Parking Brake Indicator Light: Glows (red) to indicate parking brake is applied.

Rotating Beacon Switch (optional): This switch controls operation of rotating beacon.

Seat Lock Release Lever: This lever unlocks and locks seat position adjustment. **(not shown)**

Service Brake/Inching Travel Pedal: This pedal operates the service brakes on front axle. It also permits slow travel speed while engine speed is kept high for other handler functions. The further the pedal is depressed, the slower the travel speed. Full depression of pedal causes service brake application.

Starting Aid Switch (optional): This switch engages and disengages cold weather starting aid.

Steering Wheel: The steering wheel controls the angle of rear axle wheels. Turning the steering wheel to the right causes a right turn by angling rear wheels to left. A left turn is caused by angling rear wheels to right.

Traction Lock Switch Pedal: This pedal operates traction lock valve which functions to restore traction when a wheel spins in four wheel drive.

Voltmeter: This gage indicates alternator output and battery condition.

4X2/4X4 Switch: This switch engages and disengages rear wheel drive motors. Rear drive motors are engaged for four wheel drive.

4X4 Indicator Light: Glows (amber) to indicate four wheel drive is engaged. When park brake is applied, this light will not glow.

CHECKS AND SERVICES BEFORE STARTING ENGINE

(To be performed at beginning of each work shift)

⚠ WARNING

Use extreme caution when checking items beyond your normal reach. Use an approved safety ladder.

If spark arrestors are required, be sure they are in place and in good working order.

Check to be certain that window/s and mirror/s are clean and undamaged. Also make certain that mirror/s are properly adjusted for operator's view.

Before removing filler caps or fill plugs, wipe all dirt and grease away from the ports. If dirt is allowed to enter these ports, it can shorten life of components.

When adding fluids, refer to lubrication section of this manual to determine proper type.

Complete all required maintenance before operating unit.

Service the unit in accordance with the lubrication and maintenance schedule.

Inspect all structural members, including attachment, for signs of damage.

Inspect unit for obvious damage, vandalism and needed maintenance. Check for signs of fuel, lubricant, coolant and hydraulic leaks. Open all access doors and look for loose fittings, clamps, components and attaching hardware. Replace hydraulic lines that are cracked, brittle, cut or show signs of abrasion.

⚠ WARNING

Before operating handler, complete all required maintenance. Replace or repair all damaged, worn or missing components before starting or operating handler. Failure to properly maintain handler may cause serious injury or death.

Starting Engine

⚠ WARNING

Operator must be seated with seat belt fastened, forward / reverse lever in neutral position, parking brake applied and all hydraulic controls in neutral position before starting engine.

1. Check to be sure that all controls are in neutral and that all electrical components (lights, heater, defroster, etc.) are turned off. Set parking brake.

NOTE: Engine will not start unless forward/reverse lever is in neutral and parking brake switch is in applied position.

2. Turn ignition key clockwise to ON position.

⚠ CAUTION

Turning ignition switch to START position while engine flywheel is rotating can cause serious damage to engine and/or starting motor.

3. Depress accelerator pedal approximately 1/4 to 1/3 of travel from top.
4. Turn ignition switch to START position to engage starting motor. Release key immediately when engine starts. If engine fails to start within 20 seconds, release key and allow starting motor to cool for a few minutes before trying again.

NOTE: If temperature requires the use of a starting aid, and if your handler is equipped with a factory-installed ether starting aid, depress button and release while cranking engine. Repeat if necessary. **CAUTION: Excessive ether can cause serious damage to engine.**

5. After engine starts, observe oil pressure gage. If gage remains on zero for more than ten seconds, stop engine and determine cause. Correct cause of malfunctioning before restarting engine. Minimum pressure at operating temperature:
   Low idle: ..... 10 psi (69kPa)
   Full throttle under load: ..... 30 psi (207kPa)
6. Warm up engine at approximately 1/2 throttle until engine coolant temperature reaches operating range.

Cold Weather Starting Aids

Diesel engine ignition is accomplished by heat generated when fuel/air mixture is compressed within the cylinders. Because this heat may be insufficient to start a cold engine in cold weather, the use of starting aids has become common practice.

Because of the wide variety of starting aids available it would be impractical to attempt to provide specific instructions for their use in this manual. Carefully follow instructions furnished with your starting aid.

If you use a starting aid employing ether or a similar substance pay particular attention to manufacturer's warnings.

FOR COLD STARTING
1. TURN IGNITION SWITCH TO ON POSITION
2. HOLD COLD START SWITCH ON FOR 20 SECONDS
3. TURN KEY TO START WHILE KEEPING SWITCH ON. IF ENGINE FAILS TO START IN 15 SECONDS RETURN KEY TO ON AND RELEASE SWITCH. WAIT 20 SECONDS AND REPEAT STEPS 2 & 3.

Normal Engine Operation

Observe gages frequently to be sure all engine systems are functioning properly.

The voltmeter shows the charge/discharge rate of the battery charging system. With the engine running, meter indicates alternator output (13.5 to 14 volts). With engine stopped, meter indicates battery charge (12 volts). The alternator indicator light glows (red) to indicate alternator is not charging.

Be alert for unusual noises or vibration. When an unusual condition is noticed, park machine in a safe position and stop engine. Report condition to your supervisor or maintenance personnel.

Avoid prolonged idling. Idling causes engine temperature to drop and this permits formation of heavy carbon deposits and dilution of lubricating oil by incompletely burned fuel. If the engine is not being used, turn it off.

⚠ CAUTION

Always keep engine covers closed while engine is running.

continued . . .

Stopping the Engine

Operate engine at low idle for 3 to 5 minutes before turning it off. This allows engine coolant and lubricating oil to carry excessive heat away from critical engine areas, including turbocharger.

Do not "gun" engine before shut down; this practice causes raw fuel to remove oil film from cylinder walls and dilute lubricant in crankcase.

To stop engine, apply parking brake, Lower forks fully, shift forward / reverse lever to neutral and allow engine to run at idle for 3 to 5 minutes. Then turn key counterclockwise to stop position. Be sure to remove key from ignition switch before leaving operator's cab.

WARM UP & OPERATIONAL CHECKS

(To be performed at beginning of each work shift)

Complete all required maintenance before operating unit.

The safety, efficiency and service life of your unit will be increased by performing the operational checks listed below. Items preceded by an asterisk (*) are optional and may not be furnished on your machine. **Check items during warm-up period.**

*1. Heater, defroster and windshield wiper

*2. Operating lights and rotating beacon

3. Voltmeter - should show 13.5 to 14 volt charging rate.

When engine warms to operating range, check the following items:

4. Service brake and parking brake
5. Forward and reverse travel
6. Steering (stop to stop in both directions) With engine at low idle, power assist should operate smoothly at low effort..
7. "Inching" travel - should be smooth through full pedal travel
8. Horn and back-up alarm
9. All boom and attachment functions - full function in both directions
10. Hydraulic Filter Condition Indicator - observe engine coolant temperature gage after starting normal operation. When needle has been in operating range for an hour or so, stop handler in a safe area, apply parking brake, lower forks fully, shift forward / reverse lever to neutral position and chock wheels. With engine running at full throttle, check hydraulic filter condition indicator. When needle is in red area, filter is clogged and hydraulic oil is bypassing filter. Filter element must be changed before reaching bypass condition (change before needle reaches red area).

⚠ CAUTION

Continued operation with hydraulic fluid by-passing the filter can cause severe damage to hydraulic system components.

⚠ WARNING

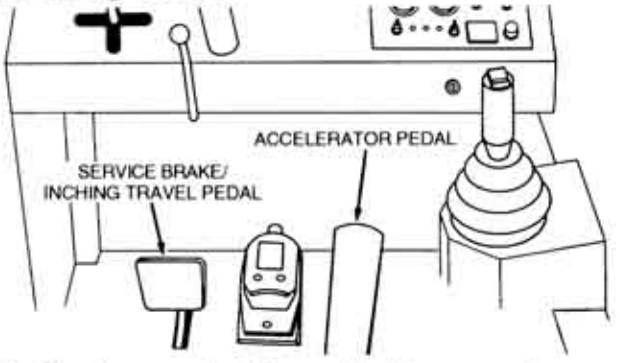
All defects must be repaired before operating unit. Failure to correct any defect can cause serious injury or death.

General

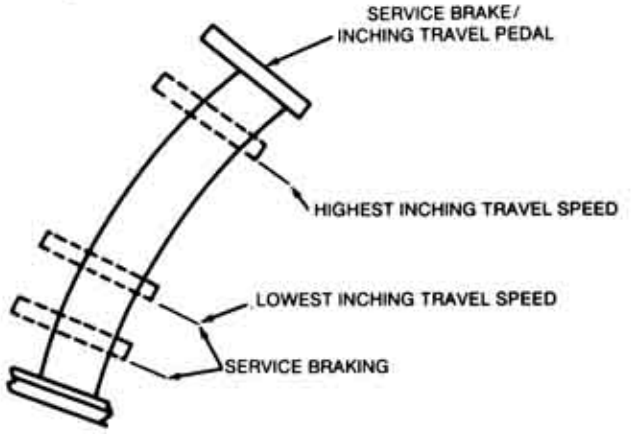
The brake system includes a service brake and a parking brake. Service and parking brakes are applied thru a pair of wet disc brake packs located within axle housing.

Because service braking and "inching" (slow travel) functions overlap, some features of inching will be discussed here. Refer to Drive Train Section for additional information on inching travel.

Inching Travel



Overlap between braking and inching occurs because the same pedal controls both functions, and also because both functions control travel speed. However, the methods of controlling travel speed are quite different: service braking involves a controlled stopping force applied to the front wheels while inching involves a controlled driving force applied to driving wheels.



Most of the inching travel pedal stroke controls the speed of inching travel. As the pedal nears the bottom of its stroke, it causes service brake application.

⚠ WARNING

Practice inching/braking in a safe, open area until you are thoroughly familiar with response of machine to pedal travel.

Service Brakes

The power-assisted service brakes are applied only to wheels of front axle. Hydraulic pressure for power assist feature is provided by a brake pump circuit.

⚠ WARNING

If power assist feature should fail for any reason IT WOULD REQUIRE GREATER EFFORT TO APPLY SERVICE BRAKE. It is extremely important that you NEVER STOP ENGINE WHILE TRAVELING.

If power assist fails, stop as soon as possible. Do not drive unit until problem has been corrected.

Depressing service brake / inching travel pedal to braking portion of pedal travel causes controlled hydraulic pressure to be applied to brake units. The greater the pedal travel, the greater the braking force.

If power assist fails, it will require much greater force on pedal to apply brake and stopping distance will be greater.

Parking Brakes

⚠ WARNING

Always move parking brake switch to ON position before leaving cab.

Never stop engine while traveling. Parking brake will be fully applied and unit may stop abruptly. A sudden stop could cause loss of control of load.

The parking brake is spring applied and hydraulically released.

Hydraulic power to release parking brake is provided by hydraulic system and is controlled by parking brake switch located on dashboard.

With engine running and parking brake switch in **OFF** position, brake is pressurized to release parking brake. Moving switch to **ON** position releases hydraulic pressure to apply parking brake. With switch in **ON** position, 4 wheel drive is disabled.

Note: In the event of engine or hydraulic failure, brake can be released for towing (ref. pages 35 & 36).

PARKING THE HANDLER

Precautions:

Avoid parking on slopes or near an excavation.

Park on level ground and block wheels.

Avoid parking on roads or highways. If it cannot be avoided be sure to display warning flags during day and flares or flashing lights at night.

Position boom head or attachment on ground; never leave machine with boom in air.

If parking on a slope cannot be avoided, position unit at a right angle (across) slope, straighten rear wheels and chock all wheels.

Parking procedure

1. Using service brake, stop unit in appropriate parking area.
2. Move parking brake switch to applied position.
3. Shift forward/reverse lever to neutral position.
4. Position boom head or attachment on ground.
5. Allow engine to cool at idle speed for three to five minutes and then stop engine.
6. Block wheels as an extra precaution against rolling.
7. Fill fuel tank to minimize condensation. Remove ignition key.
8. Lock cab and install protective covers if so equipped.
9. Disconnect batteries if unit is in an area where tampering seems possible.

STEERING SYSTEM

Ninety degree rear wheel power steering is provided to reduce operator fatigue and to permit high maneuverability in close quarters.

It is important that the operator practice maneuvering the handler in a safe, open area until he becomes thoroughly familiar with steering response and clearance required for tailswing and load when turning.

⚠ WARNING

Be alert for any increase in effort needed to steer. If any difference is noted, notify maintenance personnel immediately for correction. If power assist feature should fail for any reason IT WOULD BECOME VERY DIFFICULT TO STEER. For this reason it is extremely important that you NEVER TURN ENGINE OFF WHILE TRAVELING.

In the event power steering fails, stop as soon as possible. Do not drive unit until problem has been corrected.

General

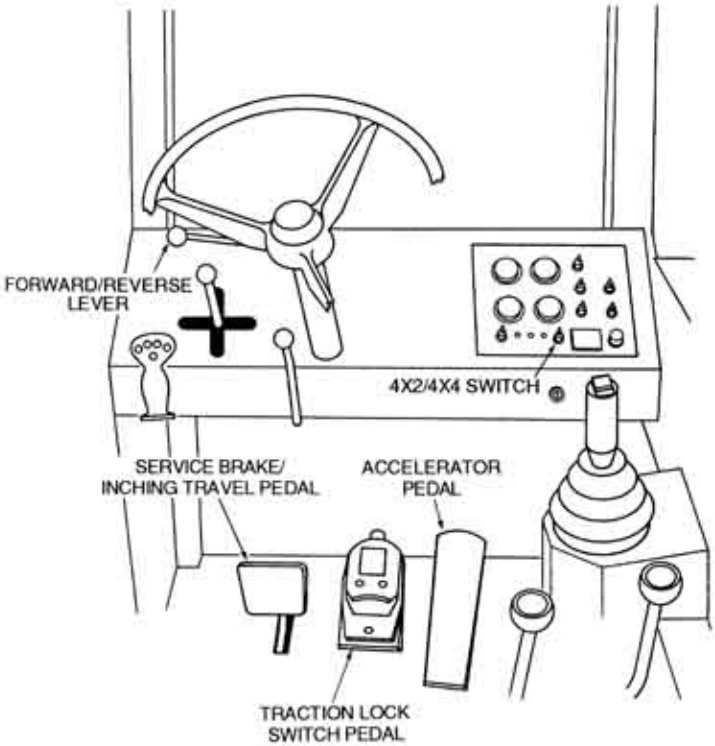
All models covered by this manual are equipped with hydrostatic drive. From the operator's standpoint, operation is similar to a vehicle with an automatic transmission.

Major components of the system include a front drive axle with a differential and planetaries. The differential receives torque from variable-displacement piston pump and motor.

This combination of components eliminates the need for a conventional mechanical transmission and also provides inching travel.

These handlers also include piston motors to provide torque to rear wheel drive hubs and an electrically controlled valve which functions to restore traction if conditions cause a wheel to spin.

Operation



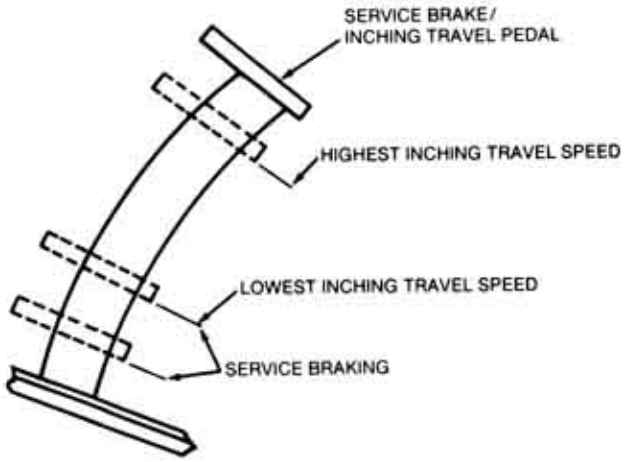
Normal Travel: Direction of travel is selected by moving forward / reverse lever forward for forward travel or to rear for reverse travel. Move lever to center position for neutral.

⚠ WARNING

Bring unit to a complete stop before shifting forward/reverse lever when carrying a load. A sudden change in direction of travel can reduce stability and/or cause load to shift or fall.

If hydrostatic drive system senses increased travel load, the system will compensate automatically by reducing travel speed to match load and engine rpm.

Inching Travel: Inching travel is provided to permit slow travel speed while maintaining high engine speed for other handler functions.



The service brake/inching travel pedal controls inching travel. The upper portion of pedal travel actuates a valve which controls travel pump output. The greater the pedal travel, the less the pump flow; the less the pump flow, the slower the travel.

The lower portion of pedal travel actuates service brake. The greater the pedal travel, the stronger the brake application. Travel flow is reduced when brakes begin to apply.

⚠ WARNING

Practice inching/braking in a safe, open area until you are thoroughly familiar with response of machine to pedal travel.

continued . . .

Four Wheel Drive: When required by travel conditions, rear-wheel (4 wheel) drive can be engaged by moving toggle switch to 4X4 position. Return unit to two wheel drive by moving toggle switch to 4X2 position.

Four wheel drive can be engaged and disengaged while traveling.

When parking brake is applied, four wheel drive is disabled.

Traction Lock Switch: This switch (pedal) controls the traction lock valve which functions to restore traction when a wheel tends to spin while in four-wheel-drive.

When switch pedal is depressed and held, traction lock valve functions to cause delivery of full drive pressure to wheels of other axle, regardless of low pressure at spinning wheel.

DO NOT engage traction lock function on improved surfaces. Unit must be in four-wheel-drive to engage traction lock function.

⚠ CAUTION

Never disengage rear hubs except for emergency towing (page 35).

BOOM

All boom characteristics shown below are common to the 534C-9 and 534C-10 handlers.

Boom elevation above horizontal is 71° and boom depression below horizontal is 7° as measured from horizontal plane at boom pivot with handler resting on a horizontal surface.

Fork height above grade is 40 feet and fork depth below grade is 3 feet as measured from horizontal plane at bottom of tires to top surface of horizontal forks.

Horizontal reach (at 0°) is 26 feet as measured from vertical plane at front of front tires to 24 inch load center.

The boom is raised and lowered by a pair of hydraulic cylinders anchored to chassis frame and to boom section number 1.

Raise boom by pulling boom control joystick to rear and lower boom by pushing joystick forward.

The boom is extended by a cylinder and a pair of cables within the boom.

Extend boom by moving boom control joystick to right and retract boom by moving joystick to left.

Boom functions can be operated simultaneously by moving joystick to a position between two single functions. Speed of a boom movement is proportional to degree of joystick actuation.

A cylinder is located within the boom head to tilt fork carriage (or other attachment) back and forth as required.

Push tilt lever forward to tilt carriage forward and pull lever to rear to tilt carriage back.

All cylinders related to boom/carriage movement (attachment tilt, boom up/down and boom in/out) are protected by counterbalance valves which prevent load from falling in event of a broken hydraulic hose or tube.

How to check & adjust boom cables

Checking and adjusting boom cables:

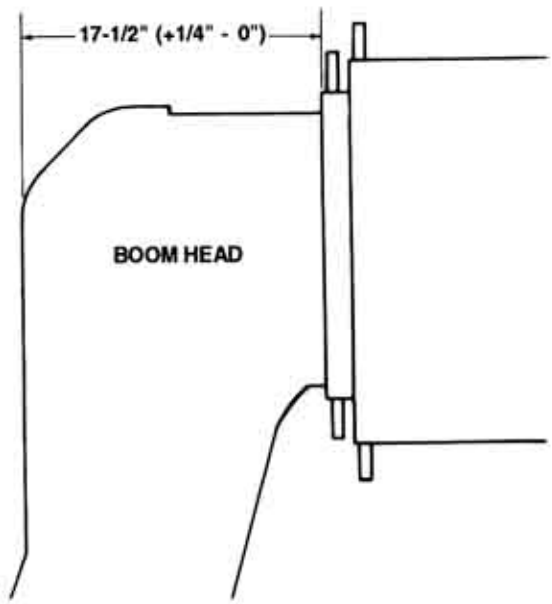
1. Position Gradall material handler in a safe, level, open area away from persons and equipment. Apply parking brake, shift forward/reverse lever to neutral position and turn rear wheels to straight forward position.
2. With boom horizontal, extend boom two to three feet and then retract boom fully.
3. Stop engine and block all wheels.
4. At rear of boom, measure gap between flat washer at **extend** cable anchor and strong back (rear plate). If gap is greater than 1/8 inch, **extend cables must be adjusted.**

NOTE: Always use wrenches to prevent boom cable from turning when turning adjusting nut or tightening jam nut.

5. To adjust **extend** cable, loosen jam nut on each **extend** cable. Tighten **extend** cable adjusting nut until gap between cable flat washer and strong back is 1/32 to 1/16 inch. When both cables are properly adjusted, gap between washers and strong back on both must be equal. Torque jam nuts to 100 ft-lbs. Be certain to perform this check/adjustment every five weeks or 250 hours.

NOTE: After several adjustments of **extend** cables, boom sections may be mis-aligned and holes in side of boom will no longer be aligned with pins in boom. When this condition occurs, **retract cable must be adjusted.** If required, perform following procedure to align boom sections:

1. Position unit as described in step 1. of **Checking and adjusting boom cables:** procedure. Then retract boom fully, stop engine and block all wheels.
2. Loosen both **extend** cable adjusting nuts (at rear of boom) far enough to permit realignment.



3. Loosen **retract** cable jam nut (located inside boom at bottom front of first (main) boom section. Tighten the **retract** cable adjusting nut to obtain 17-1/2" (+1/4" - 0") as shown. Tighten jam nut to 100 ft-lb when correct dimension is obtained.
4. Readjust **extend** cables as described in steps 4 and 5 of **Checking and adjusting boom cables:** procedure.

OUTRIGGERS

Outriggers (stabilizers) are furnished as standard equipment on 534C-10 Handlers.

Outriggers are intended to be used to increase stability. Study your load chart carefully to determine maximum capacities for various lift situations, with and without outriggers.

Outriggers are also used to level handler before picking or delivering a load (refer to LEVELING THE HANDLER heading on next page).

Outriggers are controlled by a pair of levers to the right of operators seat. The left lever controls left outrigger and the right lever controls right outrigger. Push levers forward to lower outriggers or pull levers to rear to raise outriggers.

LEVELING THE HANDLER

⚠ WARNING

Raising the boom (loaded or unloaded) when handler is leaning to the side can cause machine to tip over with little or no warning and cause serious injury or death.

"LEVELING" means positioning the handler so that it is level from side to side (left to right with respect to a man sitting in operator's seat).

A level indicator is located on upper portion of front window frame to permit operator to determine that handler frame is, or is not, level.

There are four very important things to remember about handler leveling:

1. Never engage a load or lift a load more than four feet above ground level unless the handler is level.
2. A handler with the boom raised and/or an attachment installed is a partially loaded handler.
3. Once the handler frame has been leveled, and has raised a load more than four feet above ground level, it must not be moved from its position if such movement could change the level condition.
4. The combination of side tilt and load can cause the handler to tip over.

Note: Leveling information following this note applies to all 534C-9 Handlers and also to 534C-10 Handlers if outriggers are not being used to level handler. To level handler using outriggers, position left and right outriggers as appropriate to center bubble/weight in level indicator.

There are two ways to level the handler:

1. The surface which will support the handler can be leveled. This method must be chosen if it will be necessary to move the handler from its position after the load has been raised over four feet from ground level - **AND** - such movement could change the level condition.

   Remember, the supporting surface must be large enough, smooth enough and firm enough to keep handler level when it is moved from its position.

2. The handler may be leveled by means of the frame leveling system. This method may be chosen when it will not be necessary to move the handler from its position after the load has been raised above four feet from ground level - **OR** - when such movement will not change the level condition of the handler.

Always determine best positions for handler to raise load from its present location and also to position load at its destination. **THEN**, determine which method of leveling will be required at each location.

FINALLY, consider terrain between present location of load and its destination. Never attempt to transport a load across terrain which could cause handler to tip over.

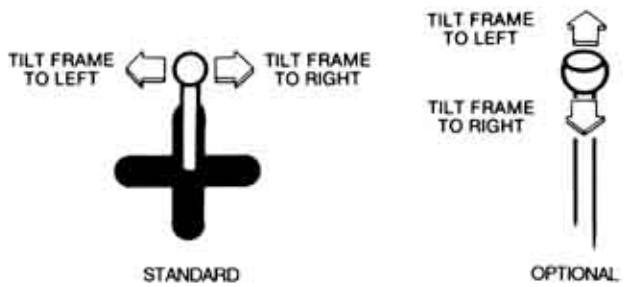
Leveling Handler Frame:

The handler is designed to permit tilting main frame eight degrees to left or right to compensate for uneven ground conditions.

The rear axle pivots at the midpoint of the main frame to help assure that wheels will remain in contact with ground. A hydraulic cylinder provides a rigid connection between front axle and main frame to help assure a solid work platform and permit tilting main frame to left or right.

Procedure:

1. Position machine in best location to lift or place load and apply parking brake.
2. Observe level indicator to determine whether machine must be leveled. Note position of indicator for later realignment.



FRAME LEVELING CONTROLS

3. If necessary to level handler, position boom in carry position and move machine level lever to level machine.
4. Lift or place load as appropriate.
5. Retract and lower boom to carry position.
6. Realign frame to position noted in step 2.

⚠ WARNING

If handler cannot be leveled using leveling system, do not attempt to raise or place load. Have surface leveled.

OPERATING PROCEDURES & TECHNIQUES

This section highlights some common procedures and discusses areas which may be new to even the experienced operator.

Hydraulic Controls

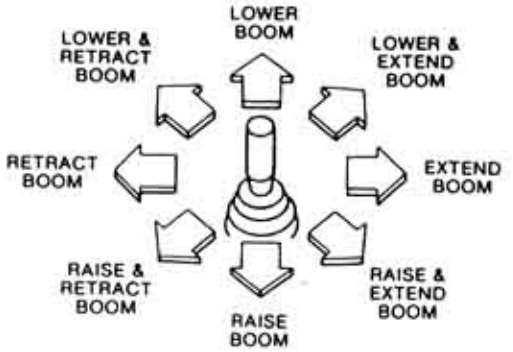
All boom and attachment movements are governed by hydraulic controls. Rapid, jerky operation of hydraulic controls will cause rapid, jerky movement of the load. Such movements can cause the load to shift or fall or may cause the machine to tip over.

Feathering

Feathering is a control operation technique used for smooth load handling. To feather controls, move control lever very slowly until load begins to move, then gradually move lever further until load is moving at desired speed. Gradually move lever toward neutral as load approaches destination. Continue to reduce load speed to bring load to a smooth stop. Feathering effect can be increased by lowering engine speed at beginning and near end of load movement.

Boom Control Joystick

The boom control joystick can be positioned to cause individual boom movements or combinations of boom movements as illustrated.



With boom raised above horizontal, forks can be inserted under a load by moving boom control joystick forward and to the right until forks move forward horizontally.

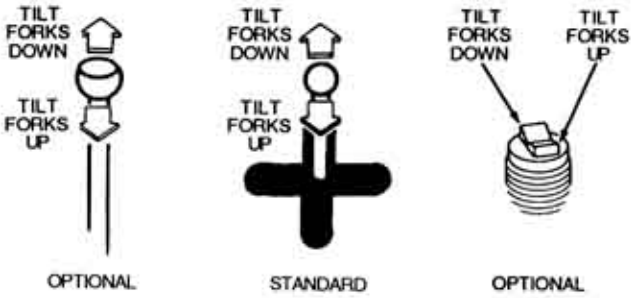
With boom raised above horizontal, forks can be removed from a load by moving boom control joystick back and to the left until forks move rearward horizontally.

With boom lowered below horizontal, forks can be inserted under a load by moving boom control joystick back and to the right until forks move forward horizontally.

With boom lowered below horizontal, forks can be removed from a load by moving boom control joystick forward and to the left until forks move rearward horizontally.

The closer the boom to horizontal, the less boom raise/lower movement required for inserting and removing forks.

Carriage Tilt Lever



FORK TILT CONTROLS

Move lever forward to tilt forks down and move lever rearward t o tilt forks up.

⚠ WARNING

Always move boom to carry position (horizontal or below) before leveling frame. Attempting to level machine with boom raised may cause it to tip over.

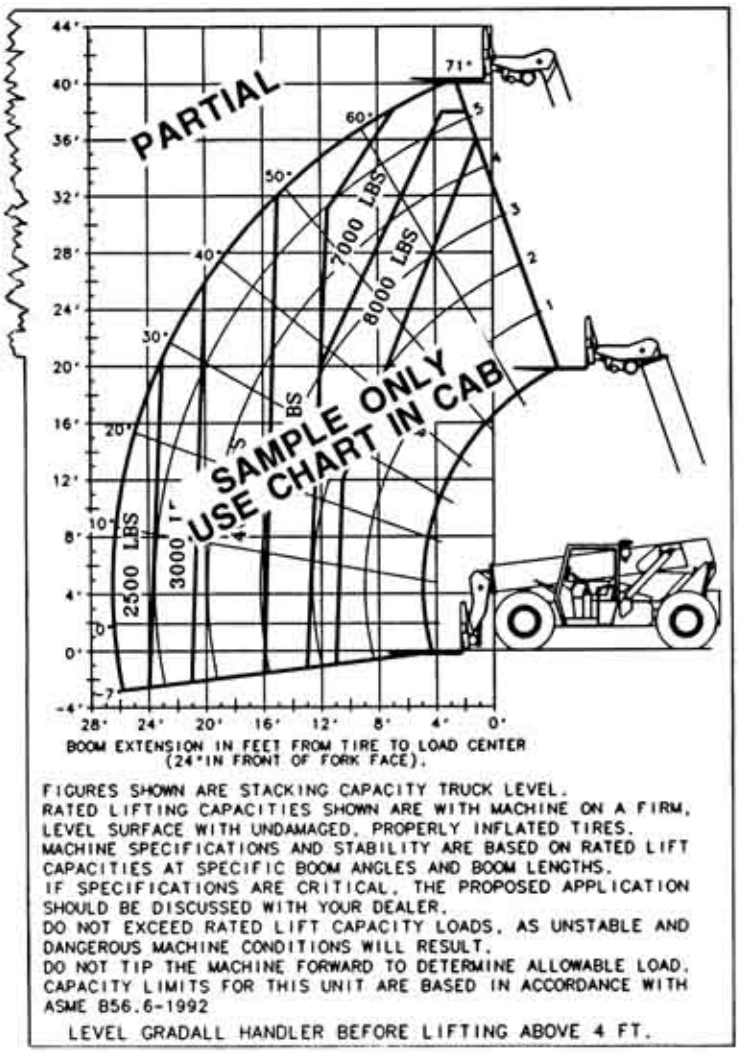
Rated Capacity Chart

The rated capacity chart, located on dashboard, indicates maximum load capacities for handlers equipped with Gradall-furnished carriage/fork combination. These capacities apply to the standard carriage/fork combinations except as stated on the capacity chart.

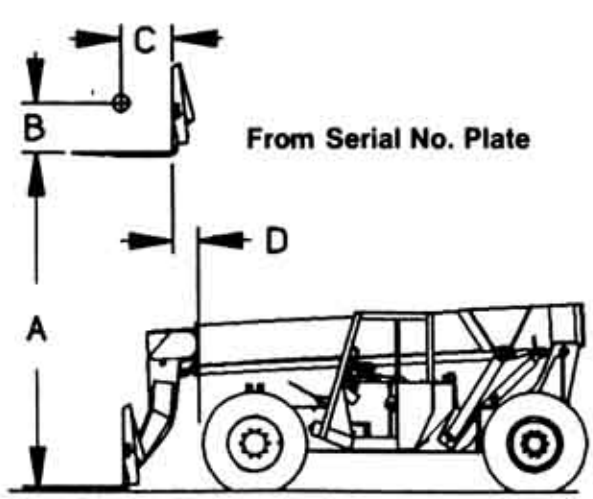
⚠ WARNING

All loads shown on rated capacity chart are based on machine being on firm, level ground; the forks being positioned evenly on carriage; the load being centered on forks; proper size tires being properly inflated; and the handler being in good operating condition.

Elevation:



Numbers at left side of sample chart (-4' to 44') represent elevation to top of horizontal fork as measured from level ground. Elevation relates to dimension "A" shown on serial number plate located on right cab wall.



From Serial No. Plate

Boom Extension

Numbers across bottom of sample chart (0' to 28') and numbers parallel to boom (1 to 5) represent boom reach as measured from front of tires to extended position.

Number decals on boom (1, 2, 3, 4 & 5) relate directly to boom extension. The largest number which can be read from operator's seat indicates total boom extension and must be matched with boom angle to determine capacity.

Boom extension relates to dimension "D" shown on serial number plate.

Boom Angle

Numbers shown at ends of angled lines (-7° to 71°) represent angle of boom to horizontal as measured from horizontal plane. Maximum angles are -7° below horizontal with boom fully lowered to 71° above horizontal with boom fully raised.

A boom angle indicator is located on left side of boom section number one to show boom angle. **Be sure machine is level from front to rear or indicator will provide incorrect reading.**

Load Center

Loads shown on rated capacity chart are based on the load center being two feet above and two feet forward of surfaces of horizontal forks as indicated by dimensions "B" and "C" on serial number plate.

The load center of a load is the center of gravity of the load. For regularly shaped loads of the same material, such as a pallet of blocks, the center of gravity can be located by measuring the load to find its center. For irregular loads, or loads of dissimilar materials, keep the heaviest part of the load as close to the heel of the forks as possible.

In all cases, the load center must be centered between the forks.

Load Limits

Some capacities shown on the rated capacity chart are based on machine stability and some are based on hydraulic lift capacity. The "common sense" or "feel" an experienced operator might apply in regard to "tipping loads" **DOES NOT APPLY to hydraulic load limits.** Exceeding load limits can cause damage or in some cases, the machine to tip over.

Approved Attachments

Although the carriage/fork combination is most frequently used, several other Gradall-approved attachments are available for use with these material handlers. Contact your Gradall Material Handler Distributor for information on approved attachments designed to solve special material handling problems.

Refer to serial number plate for list of attachments approved for use with your handler.

Non-Approved Attachments

⚠ WARNING

Attachments which have not been approved for use with your handler my cause machine damage or an accident resulting in injury or death. All attachments approved for use with your handler are listed on the handler serial number plate (located on right cab wall).

Use of non-approved attachments is **strongly discouraged** for the following reasons:

- Gradall cannot establish range and capacity limitations for "will fit", homemade, altered or other non-approved attachments.
- An overextended or overloaded handler can tip over with little or no warning and cause serious injury or death to the operator and/or those working near the handler.
- Gradall cannot assure the ability of a non-approved attachment to perform its intended function safely.
- Non-approved attachments may cause structural or other damage to the handler. Such damage could cause dangerous operating conditions resulting in serious injury or death.

Carriage/Fork Capacities

The standard carriage/fork capacity chart (located on the dashboard) indicates maximum reach and load capacities for handlers equipped with an approved carriage fork combination. **These limitations apply to standard, approved carriage/fork combination except as stated on the capacity chart.**

Non standard carriage/fork combinations (greater or lesser capacity) may be furnished by the Gradall Co. at customer request or may be available for installation because they were furnished for a different application.

If a carriage/fork combination of lesser capacity is used, **the overall machine capacity is reduced** to carriage/fork capacity as indicated on carriage/fork serial number plate.

If a carriage/fork combination of greater capacity is used, the overall machine capacity may be reduced because of additional attachment weight and/or other considerations. **Contact your local Gradall Distributor to determine capacity limitations.**

Other Attachment Capacities

A serial number/capacity plate is attached to all Gradall-furnished attachments. **Do not assume that any Gradall attachment may be used on any Gradall Material Handler.**

First, check the listing of approved attachments on handler serial number plate (located on right cab wall). If the attachment in question is not included in the list, it was **not approved for use** at time of machine shipment. Contact your local Gradall Distributor for possibility of use with special limitations.

Next, **if the attachment is approved for use** with your handler, compare maximum capacity from approved **attachment** serial number plate to maximum capacity for that attachment as indicated on **material handler** serial number plate. **The smallest of these capacities is correct for your handler.**

Attachment Installation

1. Retract Quick Switch™ (attachment tilt lever forward) to provide clearance. Check to be sure lock pin is secured in raised position with retainer pin.

2. Align boom head pivot with recess in attachment. Raise boom slightly to engage boom head pivot in recess.

3. Engage Quick Switch (attachment tilt lever backward).

⚠ WARNING

This installation procedure is designed for one-man operation. If a helper is involved, shut off the engine before proceeding to steps 4 and 5.

4. Remove retainer pin and lower lock pin fully.

5. Secure lock pin in locked position using retainer pin.

⚠ DANGER

Always be certain that carriage or attachment is properly positioned on boom head and is secured by lock pin and retainer pin. Failure to ensure proper installation could permit carriage/attachment/load to disengage and cause serious injury or death.

Attachment Operation

Operation of the handler equipped with carriage/fork combination is covered in the Gradall Material Handler Safety Manual, the EMI Rough Terrain Forklift Safety Manual and this manual.

Operation of the handler when equipped with other approved attachments is covered in this section or in separate instructions furnished with the attachment. Such separate instructions must be kept in manual holder with operator's manual.

When an attachment is installed on the handler, take extra care when engaging, securing, manipulating, transporting and positioning the load.

Operate a handler equipped with an attachment as a partially loaded handler. Pay special attention to capacity and range limits for the handler/attachment combination.

Practice operation of handler and attachment in a safe, open area, not hazardous to yourself, other persons, equipment or property. Become thoroughly familiar with response of handler and attachment to controls before operating in a work situation.

Always consider terrain between present location of load and delivery point. Never attempt to transport a load across terrain which could cause handler to tip over.

FORK POSITIONER

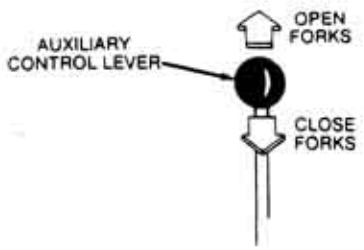
PRECAUTIONS

- **Always adjust fork position before engaging load.**
- **As with all other attachments, handler must be level before handling a load more than four feet above ground level (refer to page 20).**

Capacity:

Maximum load capacity for fork positioner carriage is the same as standard carriage without fork positioner (refer to basic Capacity Chart located on dashboard.) Capacity varies with boom extension and elevation positions.

Controls:



If your unit is equipped with a multi-function auxiliary control lever, refer to page 31.

The auxiliary control lever is used to adjust fork position. Pull lever to rear to close forks and push lever forward to open forks.

Procedure:

1. Remove standard carriage/fork combination or other attachment from boom head (refer to Attachment Installation - page 24).
2. Install carriage/fork combination with positioner.
3. Connect auxiliary hydraulic hoses to positioner cylinders.

⚠ WARNING

Observe all precautions and load capacity limits (listed previously) when handling loads with carriage/fork positioner.

4. Always adjust fork position before engaging load. Moving forks after engaging load could cause load to fall from forks.

LIGHT MATERIAL BUCKET

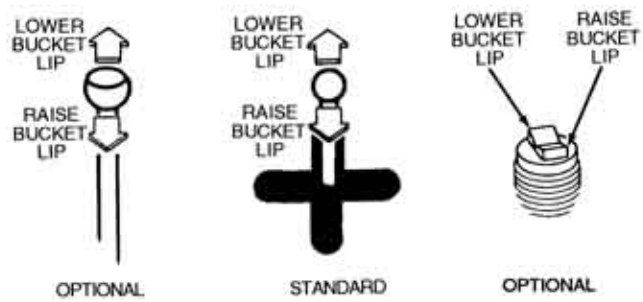
PRECAUTIONS

- **Handler must be level when handling a load more than four feet above ground level (refer to page 20).**
- **Retract boom fully before loading bucket. Loading bucket with boom extended could damage structural members or extension cables.**
- **Avoid shock loads; drive into stockpile smoothly to load bucket.**
- **Do not use bucket as a lever to pry heavy material. Excessive prying forces could damage the bucket.**
- **Do not use bucket for back-grading or quick switch lock pin may be damaged.**

Capacity:

Maximum capacity of light material bucket is shown on serial number plate (located on right cab wall) and may be used in areas where it **does not exceed** capacities shown on standard carriage/fork capacity chart. **Capacity must be reduced** for areas where maximum bucket capacity would exceed standard carriage/fork capacity chart.

Controls:



FORK TILT CONTROLS

Because the carriage tilt cylinder is used to tilt the bucket, the carriage tilt lever is used to control the bucket. Pull lever to rear to raise bucket lip and push lever forward to lower bucket lip.

Procedure:

1. Remove carriage/fork combination or other attachment from boom head (refer to Attachment Installation - page 24).

continued . . .

2. Install light material bucket on boom head.

⚠ WARNING

Observe all precautions and load capacity limits (listed previously) when handling loads with light material bucket.

3. Retract boom fully and tilt bucket up or down as required to position bottom of bucket parallel with ground.
4. Raise or lower boom to appropriate height for loading material from stockpile.
5. Align handler with face of stockpile and drive slowly and smoothly into pile to load bucket. Do not corner load bucket.
6. Tilt bucket up far enough to retain load and back away from pile.
7. Lower bucket to carry position (approximately one foot above ground) and travel carefully to unloading point. Tilt bucket down to dump load.

⚠ CAUTION

Do not use bucket for back-grading or quick switch lock pin may be damaged.

MAST (6' with 48" or 66" carriage)

PRECAUTIONS

- **Read additional capacity information under Capacity heading.**
- **Because the mast increases lift height, it is especially important to level the handler before lifting a load more than four feet above ground level (refer to page 20).**

Capacity:

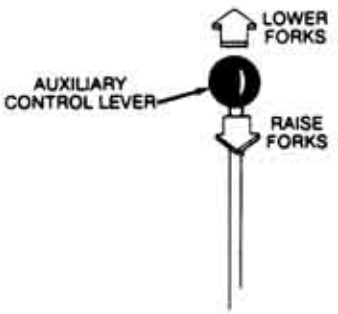
Maximum lift capacity for the mast is shown on serial number plate (located on right cab wall). However, maximum lift capacity applies only to certain areas within boom extension/elevation pattern of handler/mast combination. A separate capacity chart must be used for handlers equipped with mast. Study this chart carefully before attempting to handle a load with mast attachment.

⚠ WARNING

Do not attempt to handle a load with mast attachment until you have studied mast capacity chart carefully. If your handler does not have a mast capacity chart, ask your supervisor to get one.

Controls:

The carriage tilt cylinder is used to tilt the mast and the carriage tilt lever controls mast tilt.



If your unit is equipped with a multi-function auxiliary control lever, refer to page 31.

The auxiliary control lever is used to raise and lower the forks in the mast. Pull lever to rear to raise forks and push lever forward to lower forks.

Procedure:

1. Remove carriage fork combination or other attachment from boom head (refer to Attachment Installation - page 24).
2. Install mast on boom head.
3. Connect auxiliary hydraulic hoses to mast cylinder.
4. Always level the handler before raising the boom or the forks, with or without a load.
5. To travel with a load, lower forks fully in mast and lower boom to position load approximately one foot above ground.
6. Use mast as required to increase vertical reach of handler.
7. Use a signal man to assist in positioning the load if necessary.

SWING FORKS

PRECAUTIONS

- **Read additional capacity information under Capacity heading.**
- **Always level forks (horizontally) before swinging load to side. Swinging unleveled forks may result in load slipping from forks.**
- **Because the swing forks can swing the load to the side, it is especially important that the handler be level when handling a load more than four feet above ground level (refer to page 20).**

Capacity:

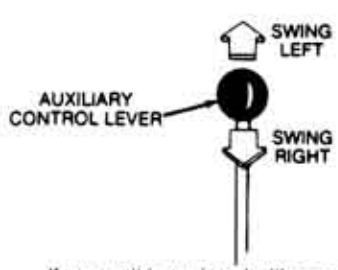
Maximum lift capacity for swing forks is shown on serial number plate (located on right cab wall). However, maximum lift capacity applies only to certain areas within boom extension/elevation pattern of handler/swing fork combination. A separate capacity chart must be used for handlers equipped with swing forks. Study this chart carefully before attempting to handle a load with swing fork attachment.

⚠ WARNING

Do not attempt to handle a load with swing fork attachment until you have studied swing fork capacity chart carefully. If your handler does not have a swing fork capacity chart, ask your supervisor to get one.

Controls:

The carriage tilt cylinder is used to tilt the swing forks up and down and the carriage tilt lever controls fork tilt.



If your unit is equipped with a multi-function auxiliary control lever, refer to page 31.

The auxiliary control lever is used to swing the forks to the left and right. Pull lever to rear to swing forks right and push lever forward to swing forks left.

Procedure:

1. Remove carriage/fork combination or other attachment from boom head (refer to Attachment Installation - page 24).

2. Install swing fork attachment on boom head.

3. Connect auxiliary hydraulic hoses to swing fork attachment.

⚠ WARNING

Observe all precautions and load capacity limits (listed previously) when handling loads with swing fork attachment.

4. Always position forks straight ahead before engaging load.

5. To travel with a load, keep forks in straight ahead position and lower load to approximately one foot above ground.

6. Inspect supporting surface at delivery point and have it leveled if necessary.

⚠ WARNING

Always bring forks to level (horizontal) position before swinging load to side. Swinging unleveled forks may result in load slipping from forks.

7. Use a signal man to assist in positioning the load if necessary.

SLOPE PILE CARRIAGE

PRECAUTIONS

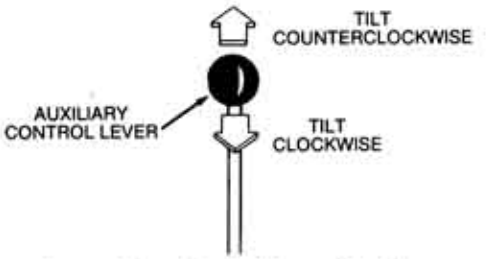
- **Level handler before tilting carriage to engage load (refer to page 20).**
- **Always level handler before lifting a load more than four feet above ground.**

Capacity:

Maximum lift capacity for the slope pile carriage is shown on serial number plate (located on right cab wall). However, maximum lift capacity applies only to certain areas within boom extension/elevation pattern of handler/slope pile carriage combination. A separate capacity chart must be used for handlers equipped with slope pile carriage. Study this chart carefully before attempting to handle a load with slope pile carriage.

Controls

The carriage tilt lever controls carriage tilt.



If your unit is equipped with a multi-function auxiliary control lever, refer to page 31.

The auxiliary control lever is used to tilt slope carriage. Push lever forward to tilt carriage counter-clockwise or pull lever to rear to tilt clockwise.

Procedure:

1. Remove carriage/fork combination or other attachment from boom head (refer to Attachment Installation - page 24).
2. Install slope pile carriage on boom head.
3. Connect auxiliary hydraulic hoses to slope pile carriage attachment.
4. Approach load with forks centered on load and stop handler.
5. Level handler before tilting carriage to engage load.
6. Tilt carriage to left or right to align forks with load and engage load.
7. Raise load slightly and then level carriage.
8. Travel with load lowered to travel position (load approximately one foot above ground).

QUICK - SWITCH MOUNTED WINCH

PRECAUTIONS

- **Maximum winch load capacity is reduced from normal carriage/fork load rating (refer to next heading - Capacity).**
- **Always level the handler before lifting a load (refer to page 20).**
- **Travel with load and boom lowered to travel position (load approximately one foot above ground).**
- **Always lower load to rest before leaving handler.**

Capacity:

The winch maximum load capacity is shown on serial number plate (located on right cab wall). However, maximum capacity may be used only in areas where it does not exceed capacities shown on standard carriage/fork capacity chart (located on dashboard). Also note that maximum winch capacity is less than carriage/fork maximum capacity. Capacity rating is based on load being lifted and suspended vertically from the boom and with no load on forks.

⚠ WARNING

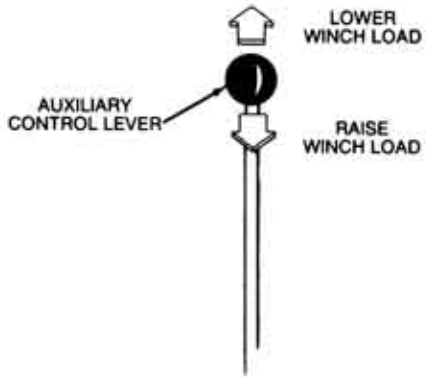
A side load or a swinging load can cause the handler to tip over and/or damage the boom.

Observe the following Special Precautions:

SPECIAL PRECAUTIONS

- **Never drag the load; lift vertically.**
- **Use tag lines to guide and steady a suspended load. Tag lines must be long enough to keep helpers clear of load and handler.**
- **Beware of wind; wind can cause a suspended load to swing and cause dangerous side loads - even with tag lines.**
- **Start, travel, turn and stop slowly to prevent load from swinging.**
- **Weight of all rigging (slings, etc.) must be included as part of load.**

Controls:



If your unit is equipped with a multi-function auxiliary control lever, refer to page 31.

The auxiliary control lever is used to control the winch. Pull the lever to rear to raise winch load and push the lever forward to lower winch load.

Procedure:

1. Remove carriage/fork combination or other attachment.
2. Install winch on boom head and connect hydraulic hoses at winch motor.
3. Position winch hook directly above balance point of load and secure using appropriate rigging.
4. Attach tag lines to load as appropriate and transport load to delivery site.
5. While helpers guide load with tag lines, position load at delivery point.

TRUSS BOOM & TRUSS BOOM WITH WINCH

PRECAUTIONS

- **Because the truss boom extends the reach of the handler, maximum load capacity is reduced (refer to next heading - Capacity).**
- **Because of extended reach, it is especially important to level the handler before lifting a load (refer to page 20).**
- **Travel with load and boom lowered to travel position (load approximately one foot above ground).**
- **Always lower load to rest before leaving handler.**

Capacity:

Maximum lift capacity for the truss boom (with or without winch) is shown on serial number plate (located on right cab wall). However, maximum lift capacity applies only to certain areas within boom extension/elevation pattern of handler/truss boom combination. A separate capacity chart must be used for handlers equipped with truss boom. Study this chart carefully before attempting to handle a load with truss boom.

⚠ WARNING

A side load or a swinging load can cause the handler to tip over and/or damage the boom.

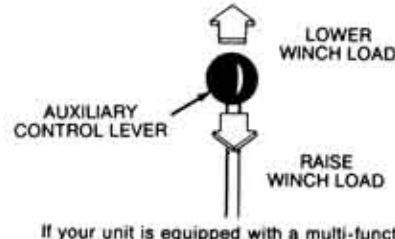
Observe the following Special Precautions:

SPECIAL PRECAUTIONS

- **Never drag the load; lift vertically.**
- **Use tag lines to guide and steady a suspended load whenever possible. Tag lines must be long enough to keep helpers clear of load.**
- **Beware of wind; wind can cause a suspended load to swing and cause dangerous side loading - even with tag lines.**
- **Start, travel, turn and stop slowly to prevent load from swinging.**
- **Weight of all rigging (slings, etc.) must be included as part of load.**

Controls:

The carriage tilt cylinder is used to tilt the truss boom up and down from the handler boom head. The carriage tilt lever controls truss boom tilt.



If your unit is equipped with a multi-function auxiliary control lever, refer to page 31.

The auxiliary control lever is used when the truss boom is furnished with a winch. Pull the lever to rear to raise winch load and push the lever forward to lower winch load.

continued . . .

Procedure:

1. Remove carriage/fork combination or other attachment from boom head (refer to attachment installation - page 24).
2. Install truss boom on boom head.
3. If truss boom winch is furnished, connect auxiliary hydraulic hoses to winch.
4. Approach truss or truss bundle with boom above and parallel to load.
5. Position truss boom approximately parallel with main boom.
6. Position truss boom/winch hook as close as possible to balance point of load and secure load to boom using short slings or other rigging. Be sure rigging will not allow load to slip in any direction.
7. Open clamps at heel of truss boom far enough to clear load and tilt truss boom up until truss/bundle contacts heel of truss boom.
8. Close clamps to hold load lightly and secure clamps.
9. Transport load to delivery site and attach tag lines if load will be freely suspended.

SWING MAST

PRECAUTIONS

- **Always level forks (horizontally) before swinging load to side. Swinging unleveled forks may result in load slipping from forks.**
- **The swing mast attachment has a smaller load capacity than the standard carriage/fork attachment. Study the swing mast capacity chart carefully before handling a load with swing mast.**
- **Read additional capacity information under Capacity heading.**
- **Because the swing mast increases lift height and can swing load to side, it is especially important to level handler before lifting a load more than four feet above ground level (refer to page 20).**

Capacity

Maximum lift capacity is shown on serial number plate (located on right cab wall). However, maximum lift capacity applies only to certain areas within boom extension/elevation pattern of handler/swing mast combination. A separate capacity chart must be used for handlers equipped with swing mast. Study this chart carefully before attempting to handle a load with swing mast attachment.

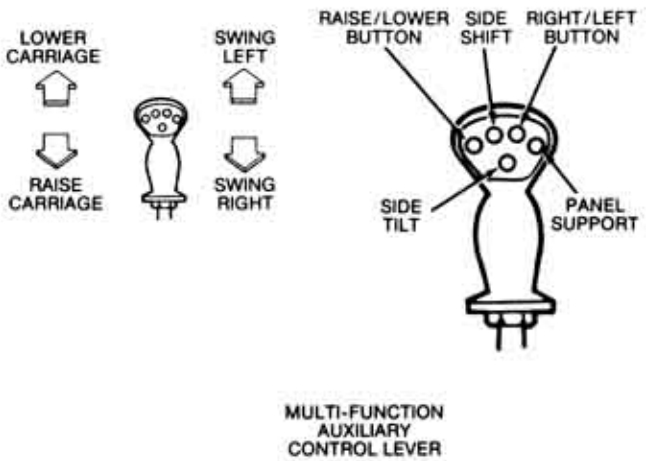
NOTE: When swing mast is equipped with an optional panel handler attachment, additional restrictions in operation and capacity will apply. Refer to Swing Mast Capacity Chart or contact your Gradall Material Handler Distributor for complete instructions and restrictions on use.

⚠ WARNING

Do not attempt to handle a load with swing mast attachment until you have studied swing mast capacity chart carefully. If your handler does not have a swing mast capacity chart, ask your supervisor to get one.

Controls:

The carriage tilt cylinder is used to tilt mast and the carriage tilt lever controls mast tilt.



MULTI-FUNCTION AUXILIARY CONTROL LEVER

A special auxiliary control lever is furnished on units equipped with swing mast attachment. The lever handle includes five push-button switches. Two of these switches are used for swing mast operation.

To raise or lower fork carriage, depress Raise/Lower button (No.1) and hold while moving lever in appropriate direction as shown.

To swing forks to left or right, depress Right/Left button (No.3) and hold while moving lever in appropriate direction as shown.

Procedure:

1. Remove carriage/fork combination or other attachment from boom head (refer to Attachment Installation (page 24).

2. Install swing mast on boom head and connect auxiliary hydraulic hoses to swing mast diversion valve hoses. Also connect electrical cable at boom head.

⚠ WARNING

Observe all precautions and load capacity limits when handling load with swing mast.

3. Always lower carriage fully in mast and position forks straight ahead before engaging load.

4. To travel with a load, keep forks straight ahead and lower load to approximately one foot above ground.

5. Inspect supporting surface at delivery point and have it leveled if necessary.

6. Level handler before raising load.

7. If necessary, perform a "dry-run" (unloaded) of delivery to determine best position for handler.

8. Use a signal man to assist in positioning the load if necessary.

Personnel Work Platform

The material handler operator and personnel in the platform must read and understand the separate personnel work platform manual (part number 9055-4001) prior to using the platform.

Capacity

The Gradall personnel work platform is designed to carry a maximum of three occupants. The load includes personnel, materials, tools, etc. The maximum capacity of your work platform is based on specific model material handler/work platform combination. To determine maximum load capacity for given operating ranges, consult the proper load capacity chart (furnished with platform) for the material handler and work platform in use. **If your handler is not equipped with the proper personnel work platform capacity chart, get one before using the attachment.**

Installation Procedure:

1. Remove carriage/fork combination or other attachment from boom head. **Refer to *Personnel Work Platform Manual* for installation procedures.**

Operation:

- Gradall Personnel Work Platforms are approved for use **only** on Gradall Material Handlers equipped with the proper platform capacity chart.
- When lifting personnel, **use only a Gradall manufactured personnel work platform**. No other platform is approved for use on Gradall Material Handlers.

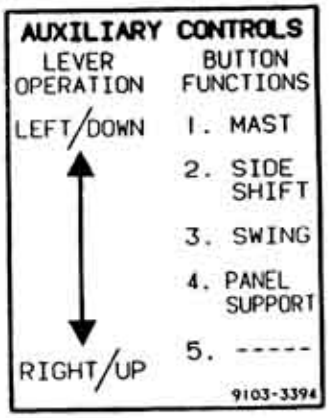
⚠ WARNING

Do not use the Personnel Work Platform until you study and understand the "Capacity Chart." If your handler does not have the correct "Personnel Work Platform Capacity Chart," ask your supervisor to get one before using the attachment.

⚠ WARNING

Do not use a boom mounted winch while the platform is mounted to the boom.

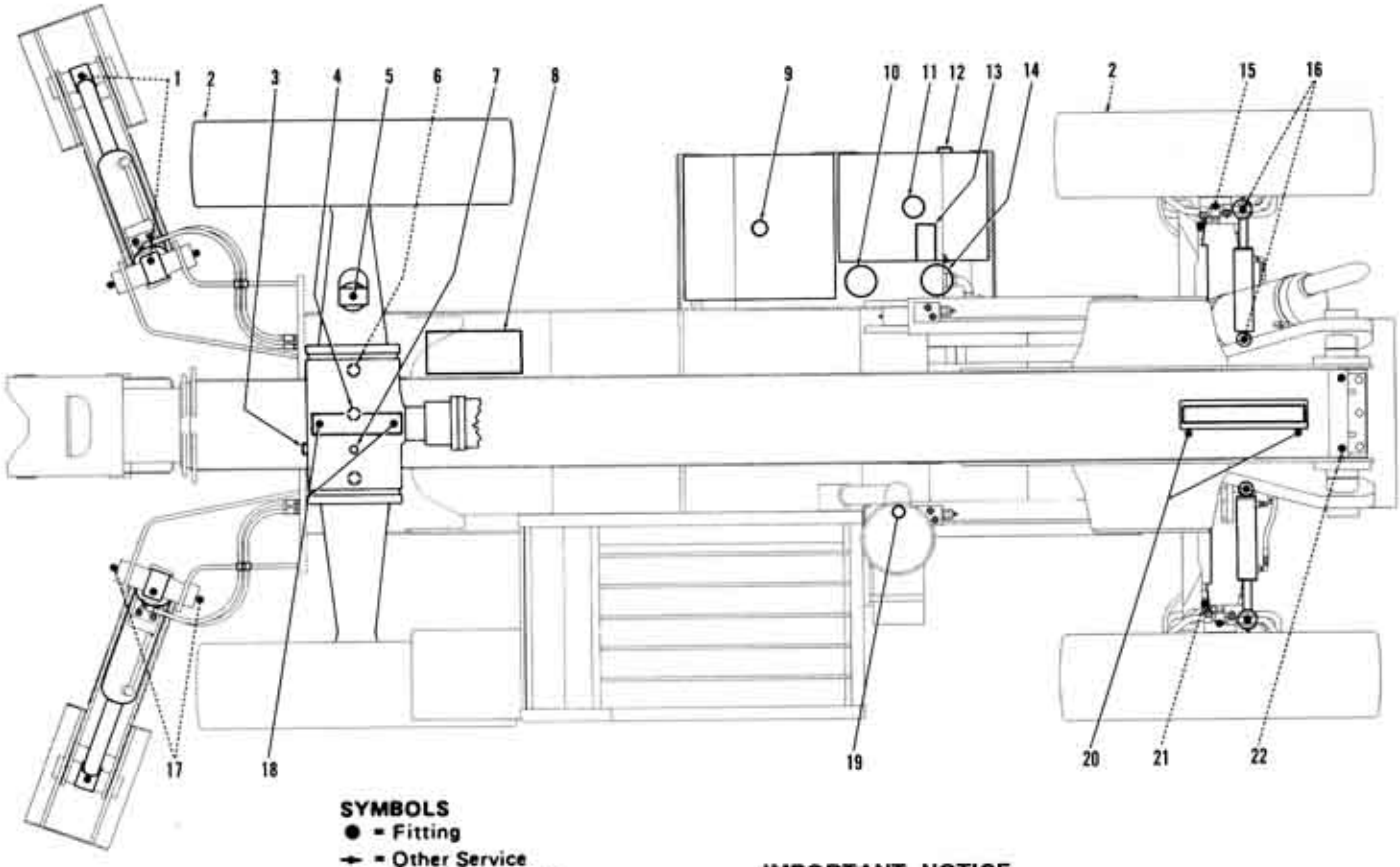
MULTI-FUNCTION AUXILIARY CONTROL LEVER



DECAL FOR PANEL HANDLER

If your unit is equipped with a multi-function auxiliary control lever, it is not necessary to depress button/s for single function attachments.

LUBRICATION & MAINTENANCE DIAGRAM



SYMBOLS

● = Fitting

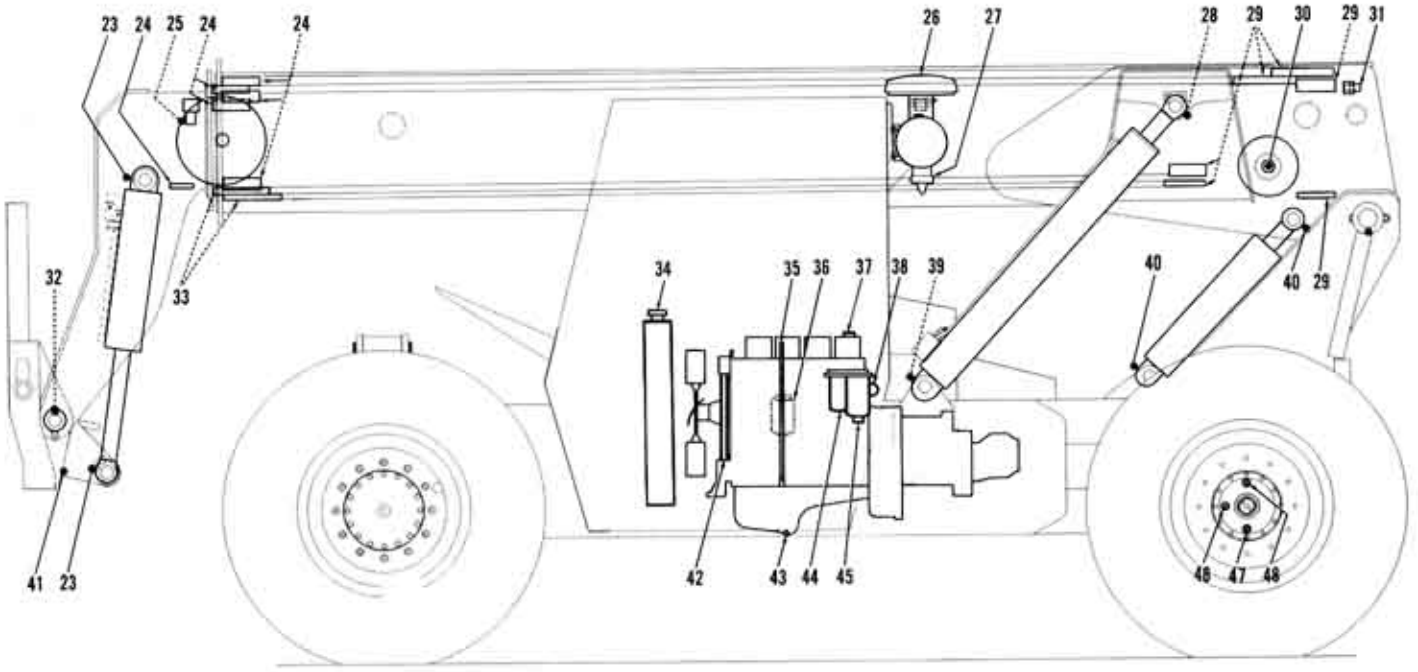
⊸ = Other Service

LUBRICANT SYMBOLS

CG - GREASE (extreme pres.)
DF - DIESEL FUEL
EO - ENGINE OIL
GO - MULTI-PURPOSE LUBE
HF - HYDRAULIC FLUID
MG - MOLY LUBE (extreme pres.)
SL - SPECIAL LUBE

IMPORTANT NOTICE

Be certain to check extend cable adjustment every five weeks or 250 hours and adjust as required. Cable damage can occur if cable is not adjusted properly. Refer to page 19 for procedure.



Failure to use Gradall Hydraulic Filter Elements could void Warranty.

SEE MANUFACTURER'S COMPONENT LITERATURE FOR ADDITIONAL LUBRICATION AND MAINTENANCE INFORMATION

CAUTION

Service intervals are based on machine usage of 1500 hours annually. Use of your unit may vary significantly and you must adjust service frequency for your usage to obtain maximum service life. Frequency headings in the following schedule indicate a calendar limit and an operating hour limit. Perform service at whichever interval occurs first.

Item	Lube Symbol	No. of Points
Daily or Shift (10 Hour Maximum) Lubrication & Maintenance (Service at whichever interval occurs first)		
9. Fuel Filler Cap (fill at end of work shift to minimize condensation)	DF	1
10. Hydraulic Return Filter Condition Indicator (check indicator with oil at normal operating temperature and engine running at full throttle - replace filter element before by-pass indication is reached or at least annually)	-	1
12. Hydraulic Level Sight Gages (level handler, retract all other cylinders & check sight gages - refill as req'd)	HF	1
14. Hydraulic Suction Filter (replace filter element when return filter element is replaced)	-	1
19. Air Cleaner Element Condition Indicator (check for clogged condition (red band showing) & clean or replace element as req'd - item 26 is air cleaner)	-	1
35. Engine Crankcase Dipstick (level Handler & check level - refill as req'd - item 37 is filler cap)	EO	1
Weekly (or 50 Hour) Lubrication & Maintenance (Service at whichever interval occurs first). (include all previous periodic services)		
1. Outrigger Cylinder Pivots	CG	4
2. Tires (check for damage & proper inflation) 534C-9: Std.: - 13.00 x 24, 12PR - 65 psi Option: - 13.00 x 24 Radial, 12 PR - 70 psi 534C-10: Std.: 14.00 x 24, 12 PR - 65 psi Option: - 14.00 x 24 Radial - 70 psi	-	4
5. Leveling Cylinder Pivots	CG	2
8. Battery (check terminals)	-	1
15. King Pins	CG	4
16. Steering Cylinder Pivots	CG	4
17. Outrigger Arm Pivots	CG	4
18. Front Axle Pivot	CG	2
20. Rear Axle Pivot	CG	2
21. Tie Rod Ends	CG	2
22. Boom Pivot	CG	2
23. Carriage Tilt Cylinder Pivots	CG	2
25. Extension Sheave	CG	2
28. Boom Hoist Cylinder Pivots	CG	2
30. Retraction Sheave	CG	1
32. Boom Head/Carriage Pivot	CG	2
33. Boom Bottom Front Slide Bearings (extend boom fully & lube all wear paths - retract & extend boom fully three times & wipe excess lube from bearings)	MG	4
34. Radiator Fill Cap (check level & refill as req'd)	-	1
39. Boom Hoist Cylinder Barrel Pivots	CG	2
40. Compensating Cylinder Pivots	CG	2
41. Quick Switch Latch	CG	1
45. Fuel/Water Separator (drain water)	-	1
At End of First 50 Hours Only		
4. Differential Drain Plug (drain & refill)	SL	1
6. Planetary Drain Plugs (drain while draining differential)	-	2
At End of First 30 Days Only (250 Hours Maximum) Lubrication & Maintenance		
• Check torque of **all items** listed in Torque Table (pg 34)	-	-

Item	Lube Symbol	No. of Points
5 Week (or 250 Hour) Lubrication & Maintenance (Service at whichever interval occurs first) (include all previous periodic services)		
3. Drive Axle Level Plug (check level & refill as req'd)	SL	1
11. Hydraulic Reservoir Breather Cap (check & clean or replace cap as req'd)	-	1
24. Boom Front, Top & Side Slide Bearings (extend boom fully & lube all wear paths - retract & extend boom fully three times & wipe excess lube from bearings)	MG	13
27. Vacuator Valve (rubber cone on bottom - check to be sure cone is clear and undamaged)	-	1
29. Boom Rear Slide Bearings (lube paths)	MG	12
31. Extend Cables (check adjustment & adjust as req'd - refer to page 19 for procedure)	-	2
33. Boom Front Bottom Slide Bearings (to be performed by experienced maintenance person - check for damage & excessive wear - no wear permitted past bevel - maximum clearance at top bearing is 1/8 inch, shim or replace as req'd; when these bearings require service, check all other slide bearings - shims are 1/16 inch thick)	MG	4
36. Engine Oil Filter (replace filter element)	-	1
42. Drive Belts (check condition & tension - replace as req'd)	-	1
43. Engine Crankcase Drain Plug (drain & refill top level)	EO	1
46. Rear Hub level Plug (check level & refill as req'd)	GO	2
• Check torque of items indicated in torque table - page 34)	-	-
Quarterly (or 500 Hour) Lubrication & Maintenance (Service at whichever interval occurs first) (include all previous periodic services)		
11. Hydraulic System (we recommend that hydraulic fluid be analyzed to determine condition - drain & refill reservoir if req'd - ref. page 35)	HF	1
13. Hydraulic Reservoir Screen (remove, clean & install when hydraulic oil is drained)	-	1
38. Fuel Strainer (replace)	-	1
44. Fuel Filter (replace filter element)	-	1
45. Fuel/Water Separator (replace filter element)	-	1
Semi-Annual (or 1000 Hour) Lubrication & Maintenance (Service at whichever interval occurs first) (include all previous periodic services)		
4/6. Differential & Planetary Drain Plugs (drain, fill to level, wait 5 minutes & fill to level again - item 3 is level plug)	SL	1
7. Front Axle Breather (clean or replace)	-	1
11. Hydraulic Reservoir Breather Cap (clean or replace)	-	1
47. Rear Hub Drain Plug (drain & refill - item 48 is fill plug)	GO	2
Annual (or 1500 Hour) Lubrication & Maintenance (Service at whichever interval occurs first) (include all previous periodic services)		
10. Hydraulic Return Filter (replace filter element)	-	1
11. Hydraulic System (unless fluid is analyzed quarterly to determine degree of contamination, reservoir must be drained and refilled on an annual basis)	HF	1
13. Hydraulic Reservoir Screen (remove, clean & install when hydraulic oil is drained)	-	1
14. Hydraulic Suction Filter (replace filter element)	-	1
34. Engine Cooling System (drain, flush & refill on basis of period suggested by anti-freeze manufacturer)	-	1

Lubrication Notes

- Lubricate points indicated by dotted leaders on both sides of unit.
- Intervals shown are for normal (8 hour day) usage and conditions. Adjust intervals for abnormal usage and conditions.
- See recommended lubricants (page 34).
- Apply a light coating of engine oil to all linkage pivot points.
- Clean lubrication fittings before lubricating.
- Clean filter housings using diesel fuel. Dry components thoroughly using a lint free cloth.
- Check lubricant levels when lubricant is cool. Also check appearance for contamination.
- Drain engine and gear cases only after operation when lubricant is hot.
- Refer to page 35 for procedure to obtain oil sample for analysis.

Recommended Lubricants & Capacities

APPLICATION	SYMBOL	WHEN USED	GRADE	SPECIFICATION	CAPACITY*	
					ENGLISH	LITERS
Boom Cable Adj. Threads	MY (moly lube)	All Year	-	P/N 1440-3323	-	-
Boom Slide Bearing Paths	MG (extreme pres. moly lube)	All Year	NLGI #2	**	-	-
Engine Cooling System	AF 50% Anti-Freeze / 50 % Water	All Year	Permanent	-	24 qts.	22.7
Engine Crankcase	EO (engine oil)	All Year	15W-40-CD	MIL-L-2104D	12 qts.	11.4
Front Axle	SL (special lube)	All Year	***	***	40 pints	19
Fuel Tank	DF (diesel fuel)	All Year	#2	-	38 gal.	144
Grease Fittings	MG (extreme pres. moly lube)	All Year	NLGI #2	**	-	-
Hydraulic System	HF (hydraulic fluid)	All Year	46	****	47 gal.	178.1
Rear Hubs	SL (special lube)	All Year	***	***	4 pints ea.	1.9

*Capacities are approximate; check level to be sure.

**Union 76 Megaplex XD2

***Tractor Hydraulic Fluid:
Pour point -46° F.; SSU @ 100° F. 275; Flash Point 442° F.
Approved Supplier & Type: Mobile Mobilfluid 424 **ONLY**

****Hydraulic Fluid Specifications:
Pour point -46° F.; SSU @ 100° F. 275; Flash Point 442° F.
Approved Supplier & Type: Mobile Mobilfluid 424 **OR** Citgo Tractor Hydraulic Fluid #33310

Torque Chart

Check torque using an accurate torque wrench to apply maximum torque value shown.
DO NOT EXCEED MAXIMUM TORQUE. Exceeding maximum torque may cause fastener to fail.

ITEM	FREQUENCY*	THREAD SIZE (GRADE)	TORQUE (lubricated)			
			POUND / FEET		NEWTON / METRES	
			MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
BOOM SLIDE BEARINGS (front)	5 Weeks (250 hours)	3/8 - 24 (5)	32	37	43	50
	5 Weeks (250 hours)	1/2 - 20 (5)	68	78	92	106
BOOM SLIDE BEARINGS (rear)	**	3/8 - 24 (5)	32	37	43	50
	**	1/2 - 20	68	78	92	106
†BOOM EXTEND CABLE (at rear):						
Adjusting Nut	5 Weeks (250 hours)	1 - 8 (-)	†	†	†	†
Jam Nut	5 Weeks (250 hours)	1 - 8 (-)	100	110	137	150
WHEEL LUG NUTS	3 Months (500 hours)	-	350	400	476	544

* Check torque at whichever interval occurs first.

**Check torque of rear slide bearings if front bearings have become loose.

†Refer to page 19 for procedure to check and adjust cables.

1. Operate unit until hydraluic oil reaches normal operating temperature.
2. Apply parking brake and observe hydraulic filter by-pass indicator with engine running at full throttle. Replace filter elements if necessary.
3. Obtain a container to receive waste oil and a **CLEAN** container to receive oil sample.

4. With gage removed from hose, attach mini-check and hose to test port near right wall of engine compartment. Hose end must be positioned in waste oil container.
5. Allow at least one pint of oil to flow into waste oil container to eliminate any contamination from hose.
6. Move hose to **CLEAN** container to collect sample for analysis.
7. Return hose to waste oil container and disconnect adapter from mini-check test port.
8. Cover sample container immediately with **CLEAN** cap.
9. Stop engine and check oil level in reservoir and replenish as required.
10. Contact your Gradall Distributor for information concerning oil analysis.

Oil sample containers are available from several sources:

- Oil Companies
- Oil Suppliers
- Sampling Labs
- Gradall Company

OIL CLEANLINESS IS A MUST. The filtration system is designed to maintain an ISO cleanliness ratio of 18/15 or better.

MOVING HANDLER IN EMERGENCY

The following information assumes the handler cannot be moved under its own power.

Before moving the handler, read all of the following information to understand options available and then select a method appropriate to your situation.

The safest way to move a disabled handler is to use a trailer of sufficient capacity.

The ability to steer handler increases the safety of moving the unit in some situations. The steering system permits manual steering if engine or power assist feature fails. However, **remember the following:**

- Although manual steering is possible without power assist, **steering will be slow and will require much greater force.**
- **Rear drive hubs must be disengaged**
- **Response to manual steering will be increased** if parking brake is released and front axle drive is by-passed to permit front wheels to roll.

MOVING SHORT DISTANCES

If it is only necessary to move handler a short distance (less than 100 feet) it is permissible to use a vehicle of sufficient capacity to tow the unit with no previous preparation. Drive wheels will not roll.

If the unit must be moved more than 100 feet (but less than 200 yards) it is permissible to use a vehicle of sufficient capacity to tow unit after completing following preparations:

- Disengage rear hubs.
- By-pass front drive system.
- Release parking brake.

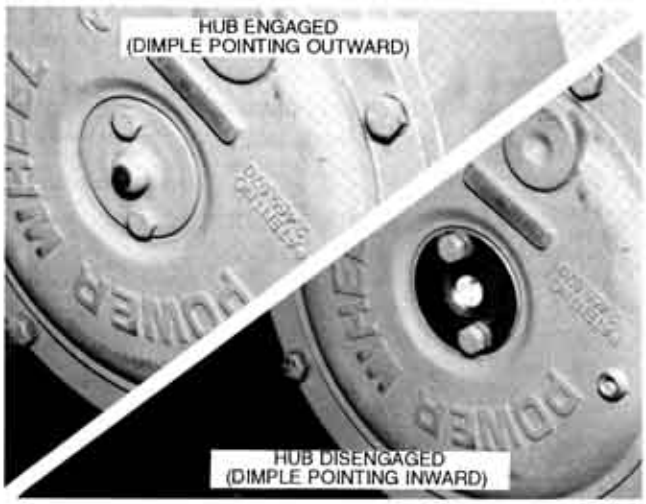
continued. . .

Towing handler with all wheels on ground for more than 200 yards can cause serious damage to hydraulic drive components.

MOVING LONGER DISTANCES

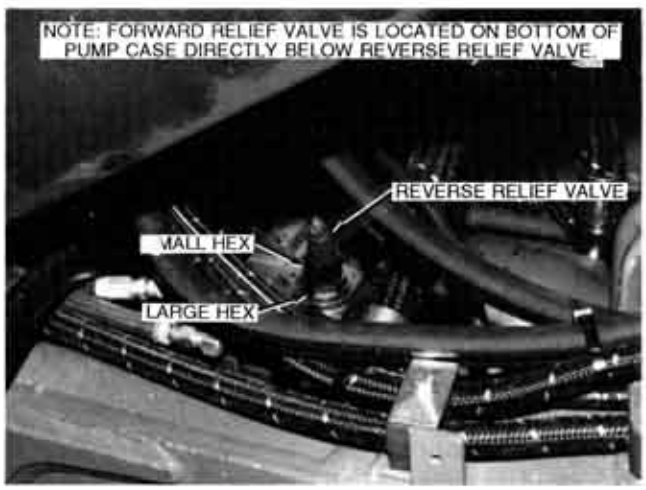
If unit must be moved more than 200 yards it should be loaded on a trailer of sufficient capacity.

To Disengage Rear Hubs



Secure both rear hub engage/disengage plates with dimple pointing inward to disengage rear drive hubs.

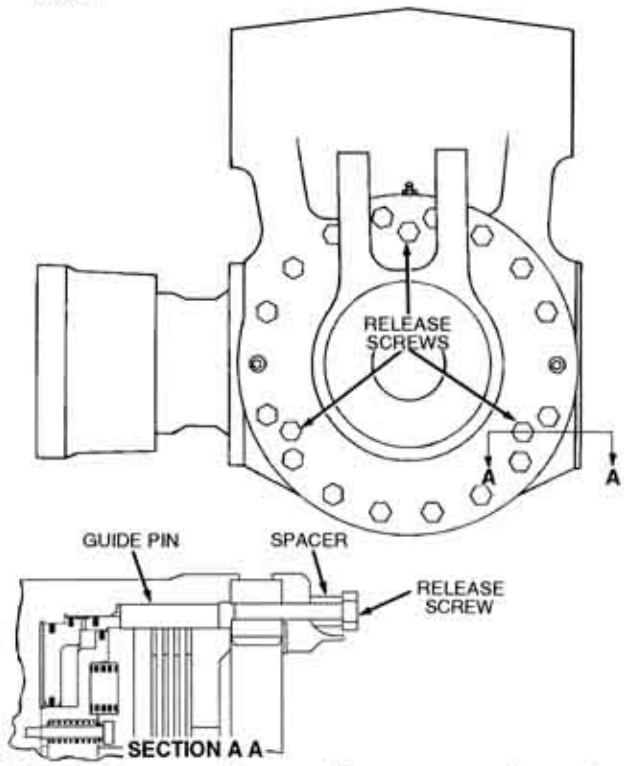
To By-Pass Front Drive



1. Mark position of relief valve cartridge (small hex).
2. Hold large hex to prevent movement and loosen reverse relief valve cartridge (small hex) two full turns.
3. Repeat steps 1 and 2. for forward relief valve. Front axle drive is now by-passed.
4. Before returning machine to service, be certain to **return relief valve cartridges to original position and re-engage rear drive hubs.**

To Release Parking Brake

1. If possible, position unit on level ground, lower attachment to approximately one foot from ground, move forward/reverse lever to neutral position, apply parking brake and stop engine.
2. Install wheel chocks at all wheels to prevent movement.



3. Working one side at a time, remove three release screws and spacers from side of differential housing (located at 12 o'clock, 4 o'clock and 8 o'clock).
4. Put spacers aside and install release screws. Tighten each screw lightly until it just makes contact with guide pin.
5. Working carefully, tighten each release screw **only 1/4 turn (90 degrees)** at a time, in sequence, until all three screws have been turned one full turn (360 degrees[approximately 50 lb./ft]). **Larger turns could cause components to bind and cause brake failure.**
6. Repeat this procedure on other side of differential. Parking brakes should be released.

To Restore Parking Brake

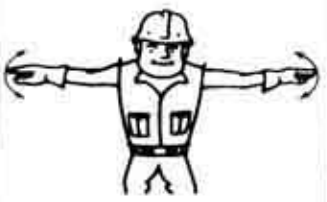
1. Check to be certain engine is stopped and all wheels are chocked to prevent movement.
2. Loosen each release screw, **only 1/4 turn at a time,** in sequence, until each screw has lost contact with guide pin. Then remove release screws.
3. Install spacers and release screws and torque to 50 to 70 lb/ft.
4. Repeat procedure on other side of differential. Parking brake should be restored to operation.

HAND SIGNALS

Standard Signals - When handler work conditions require hand signals, they shall be provided or posted conspicuously for the use of both signalman and operator. No handler motions shall be made unless signals are clearly understood by both signalman and operator.

Special Signals - When signals for auxiliary equipment functions or conditions not covered are required, they shall be agreed upon in advance by the operator and signalman.

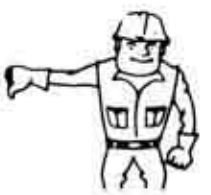
Instructions - When it is desired to give instructions to the operator other than provided by the established signal system, all handler motions shall first be stopped.



EMERGENCY STOP - With both arms extended laterally, hands open downward, move arms back and forth

STOP - With either arm extended laterally, hand open downward, move arm back and forth

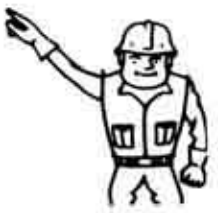
RAISE BOOM - With either arm extended horizontally, fingers closed, point thumb upward



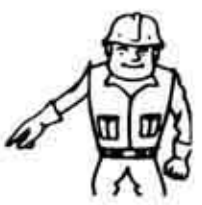
LOWER BOOM - With either arm extended horizontally, fingers closed, point thumb downward

EXTEND TELESCOPIC BOOM - With both hands clenched, point thumbs outward.

RETRACT TELESCOPIC BOOM - With both hands clenched, point thumbs inward.



TILT FORKS UP - With one arm held at side, extend other arm upward at about 45°



TILT FORKS DOWN - With one arm held at side, extend other arm downward at about 45°.

CLOSE BUCKET - Hold one hand closed and stationary. Rotate other hand in small vertical circle with forefinger pointing horizontally at closed hand.

OPEN BUCKET - Hold one hand open and stationary. Rotate other hand in small vertical circle with forefinger pointing horizontally at open hand.

MOVE SLOWLY - Place one hand motionless in front of hand giving motion signal. (Raise load slowly is shown.)

THIS FAR TO GO - With hands raised and open inward, move hands laterally, indicating distance to go.

STOP ENGINE - Draw thumb or forefinger across throat.

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

CALIFORNIA

Proposition 65 Warning

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Wash hands after handling!

GRADALL® Material Handlers

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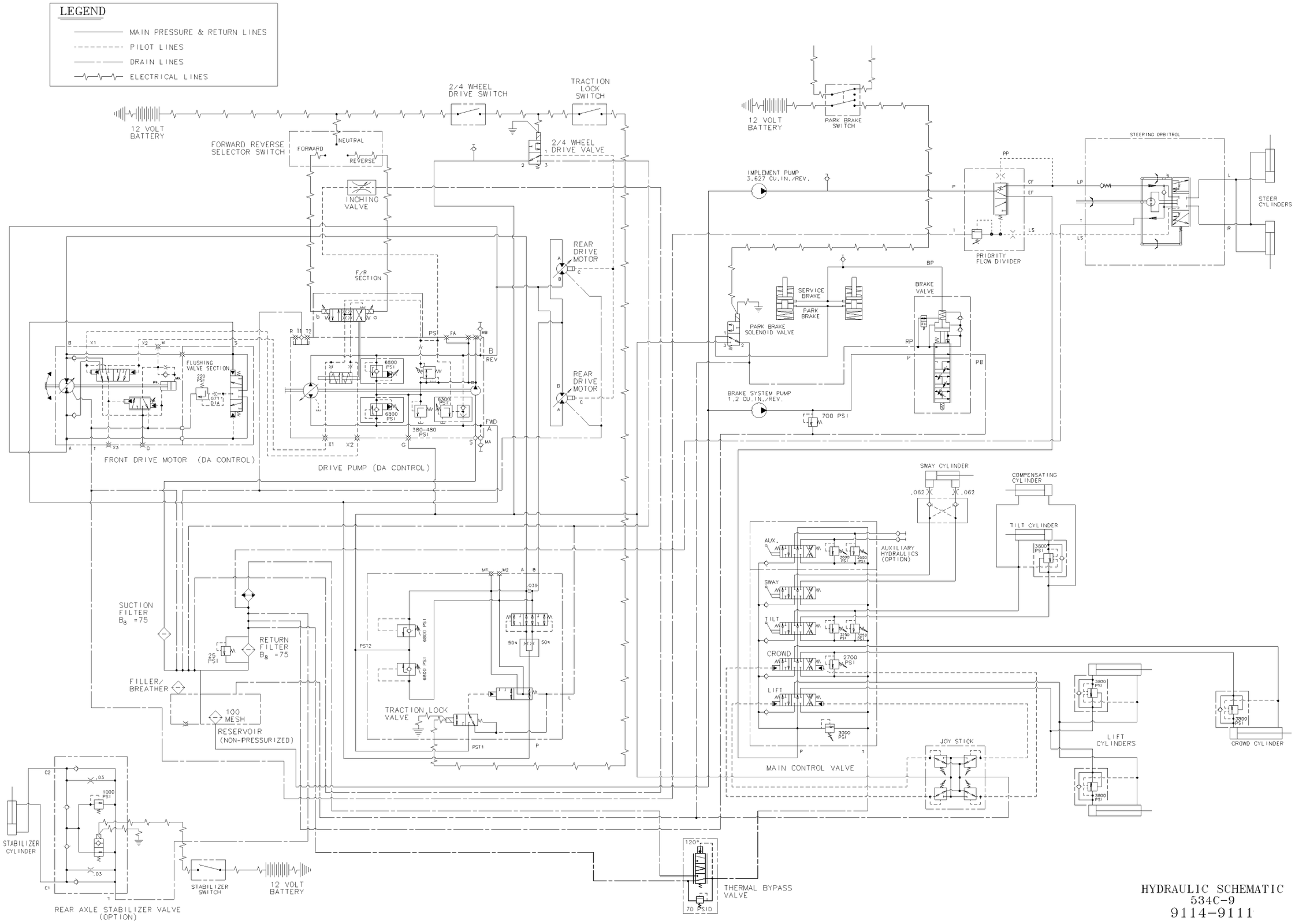
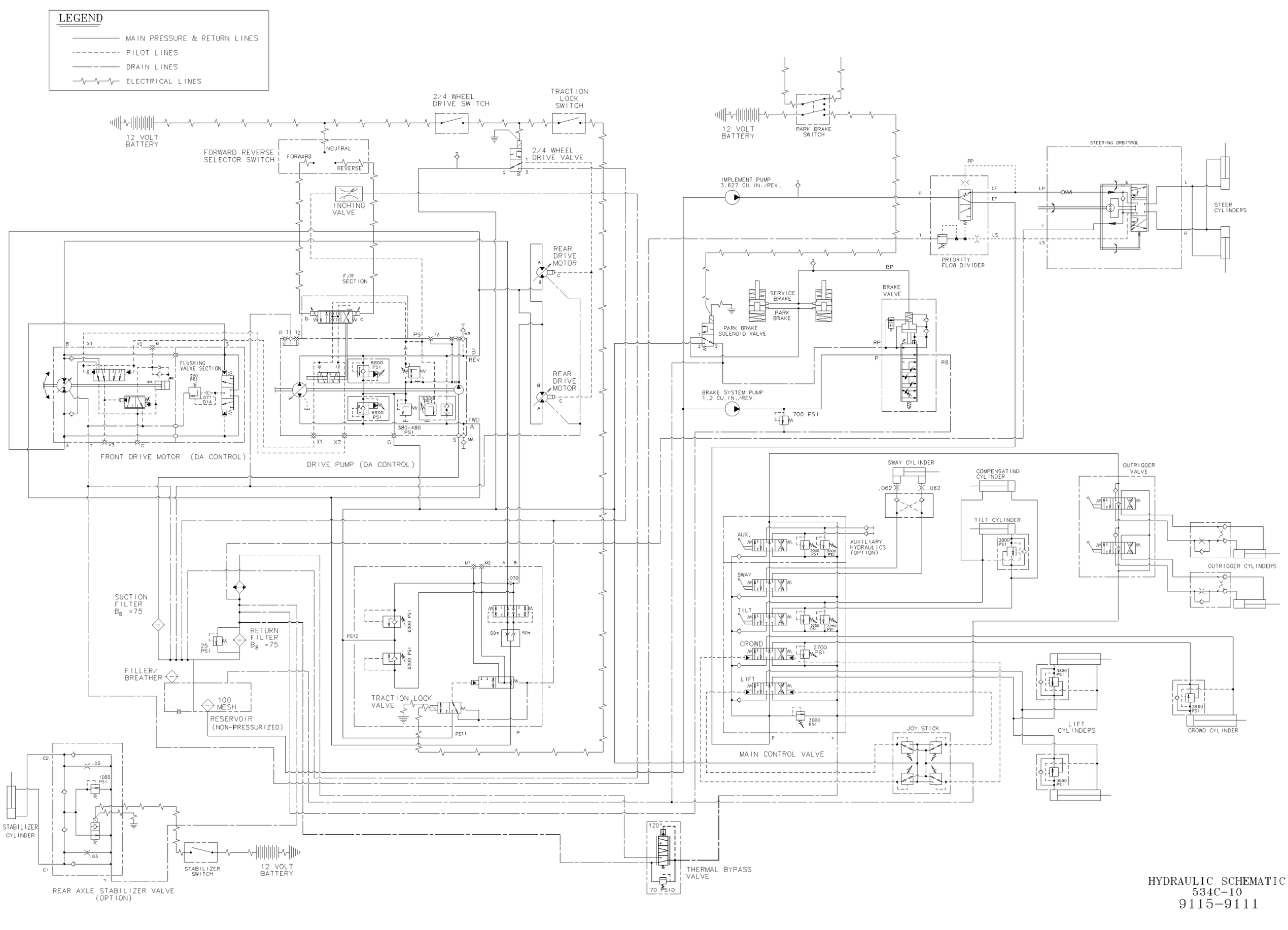


HYDRAULIC SCHEMATIC
534C-9
9114-9111

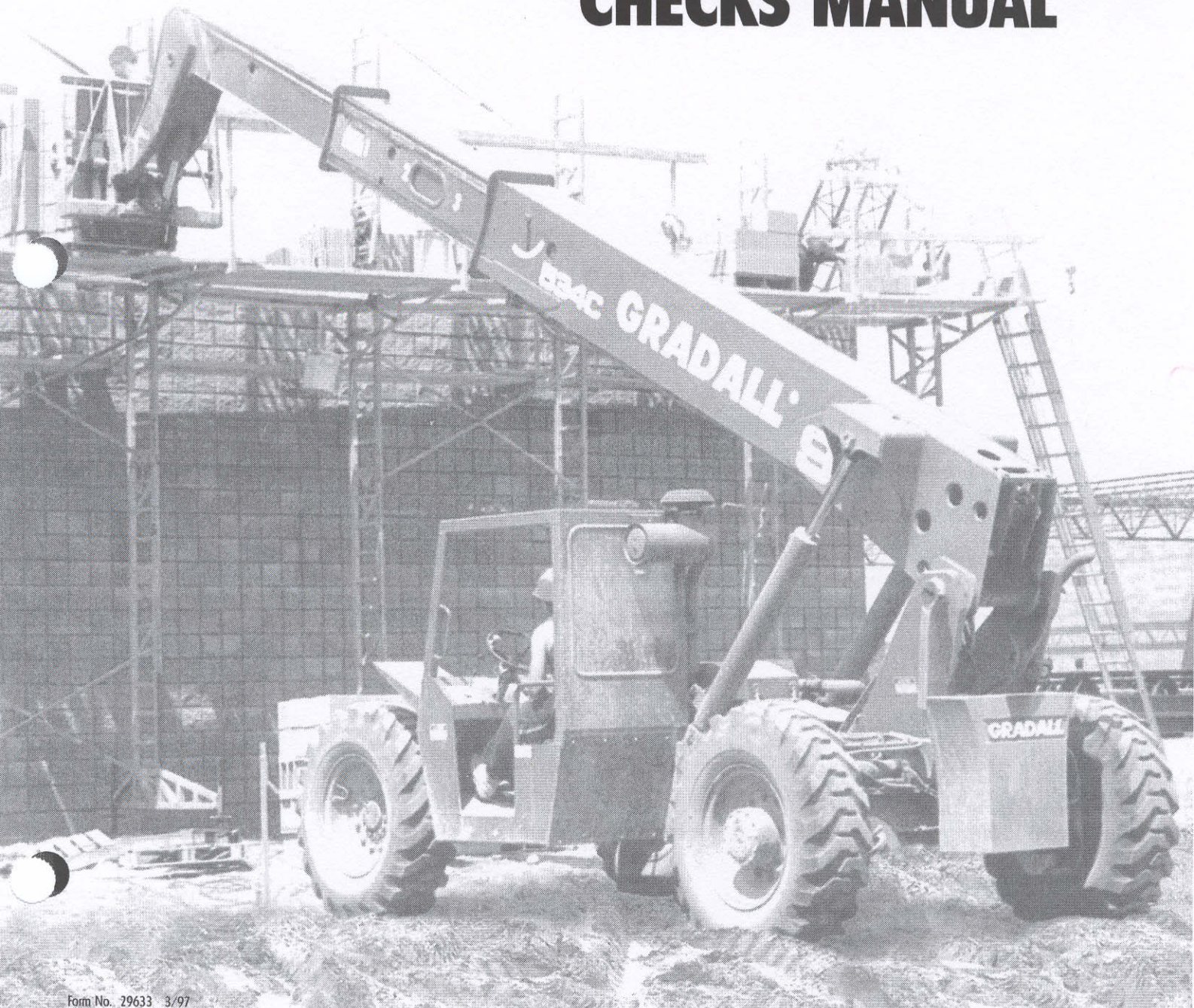


HYDRAULIC SCHEMATIC
534C-10
9115-9111

GRADALL®

MATERIAL HANDLERS

534C-9 & 534C-10 HYDROSTATIC DRIVE PERFORMANCE CHECKS MANUAL



Form No. 29633 3/97

534C-9 & 534C-10 HYDROSTATIC DRIVE PERFORMANCE CHECKS MANUAL

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NOTE! "HIGH PRESSURE" denotes 10,000 PSI gauge
"LOW PRESSURE" denotes 1,000 PSI gauge

* Component changes occur in production. Where the change affects a particular performance check, it will be noted. All other components shown will be current.

Important Safety Notice

These tests ensure that the Hydrostatic Material Drive System operates to the proper specifications. All tests should be done in a safe, open area. Apply the park brake and leave the shifter in neutral unless otherwise noted. The boom and attachment should rest on the ground unless the machine is being driven. Safe working habits must be used for these checks. Refer to **Operator's Manual** (Form No. 29311) for further information.

Read and understand this Manual, along with **Operation and lubrication Manual**, EMI Handler Safety Manual, **GRADALL Material Handler Safety Manual** and all instructional decals and plates before starting, operating or performing mechanical adjustments and maintenance procedures on this equipment. **Keep Operator and Safety Manuals in cab.**

Safe operation depends on reliable equipment and proper operating procedures. Performing the adjustments and repairs described in this Manual will help to keep your Material Handler in reliable condition. Use of the recommended operating procedures can help you avoid accidents. Because some procedures may be new to even the experienced technician, we recommend that this Manual be read, understood and followed by all who service this unit.

!DANGER, !WARNING, !CAUTION notes in this Manual will help you avoid injury and damage to this equipment. These notes are not intended to cover all eventualities. It is impossible to anticipate and evaluate all possible applications and methods of operation for this equipment.

Any procedure not specifically recommended by GRADALL must be thoroughly evaluated from the standpoint of safety before it is placed in practice. If you are not sure, contact your GRADALL Distributor before operating. Do not modify this machine without written permission from GRADALL

The following symbols are used to call your attention to safety notices

DANGER: This symbol indicates an extreme hazard which could result in high probability of death.

WARNING: This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.

CAUTION: This symbol indicates a hazard which could result in injury or damage to equipment or property if proper precautions are not taken.

Required Tools

Color-coded plastic caps seal the adjustments on components in the hydraulic system. If a GRADALL Distributor makes an adjustment, the component should be sealed with a blue cap.

The tools needed to make these checks are:
1. Tachometer
2. GRADALL pressure testing kit P/N 7713-4197
3. Mechanic's hand tools (Metric included)
4. Blue plastic caps: P/N 8093-4459 (small) and P/N 8093-4460 (large)

General Warning Information

This Manual provides important information for those responsible for understanding, troubleshooting, testing, repairing and/or performing maintenance on the hydrostatic transmission drive system of 534C-9 and 534C-10 Material Handlers.

NOTE! This Manual does not cover any of the implement systems of the machine.

Accidents involving injury or serious machine damage

Immediately notify your GRADALL Distributor of the incident so he may assist you in your investigation of the problem. If he is unavailable, contact the GRADALL Service Department at (330) 339-2211.

Related Manuals and Decals

Separate publications are furnished with your Material Handler to provide information concerning safety, replacement parts operation, maintenance procedures and vendor components. Replacement manuals and decals can be ordered from your GRADALL Distributor.

Orientation

When used to describe location of components on the machine, the directions front, rear, left and right relate to the orientation of a person sitting in the operator's seat in the cab.

Welding

CAUTION

If welding on the machine becomes necessary, place the ground adjacent to the area being welded. This will prevent arcing-between components such as bearings or machined surfaces which could cause machine damage and downtime.

1. Welding rod repairs should meet 70,000 PSI minimum tensile strength, low hydrogen process.

2. The battery leads must be disconnected before welding to prevent damage to electrical components.

Fasteners

1. Grade 8 bolts are used whenever two machined surfaces or major assemblies are bolted together. Torque values for the application will be called out.

2. Grade 5 bolts are used to fasten non-machined areas such as sheet metal. Refer to bolt torque chart in **Operator's Manual.**

3. Dowel pins are used in assemblies to absorb the shear load to these components and assist in correct positioning for bolt insertion.

Testing and Adjustment Precautions

1. Read and understand the manuals named under the important safety notice heading above. Be sure you are familiar with the machine's response to controls.

2. Read and understand all material relating to area to be checked, adjusted or repaired.

3. This Manual covers hydraulic testing and adjustments. Read and understand material related to hydraulics before proceeding with service of any kind on the hydraulic system. When performing maintenance, be sure there is no residual, trapped hydraulic pressure.

4. If you are working with a helper, be sure he understands the procedure. Be certain each of you knows what to

expect from the other, and when to expect it.

5. Be sure you understand all steps of the procedure before testing, adjusting or repairing any component or mechanical assembly. Follow the procedure carefully.

6. Always wear safety glasses, hard hat and any other locally required safety-related, protective apparel when performing testing and adjusting procedures.

7. Thoroughly clean all areas before working on them. Slippery and contaminated surfaces can cause serious accidents or mechanical failure if not removed.

8. Always mechanically secure machine components that could suddenly start in motion and cause injury or damage.

9. Remove key from ignition and place a sign in the operator's cab informing all who come in contact with the machine that it is being worked on and that personnel are on the machine.

Do not move any function.

10. Double check bolt torques.

11. Check that all lubrication fluids are at the correct level.

12. Remove mechanical restraints before restarting and operating the machine following repairs.

13. Clear all personnel from area adjacent to the machine when first operating after a repair or adjustment. This can eliminate the possibility of personal injury if repairs or adjustments were performed incorrectly and/or if the machine performs in an uncontrollable or unexpected manner.

14. Clean machine surfaces before returning it to work.

I. Hydraulic Oil Reservoir

Make sure that the machine is level before retracting all cylinders. Proper level is to full mark +/- 1/4 inch in the sight gauge located on the outside of the reservoir. The system contains 47 gallons of hydraulic oil. Refer to the "Lubrication Specifications Chart" in the **Operator's Manual.** Oil should be in good condition.
See Figure 1 and Figure 2.

FIGURE 1
HYDRAULIC RESERVOIR ASSEMBLY

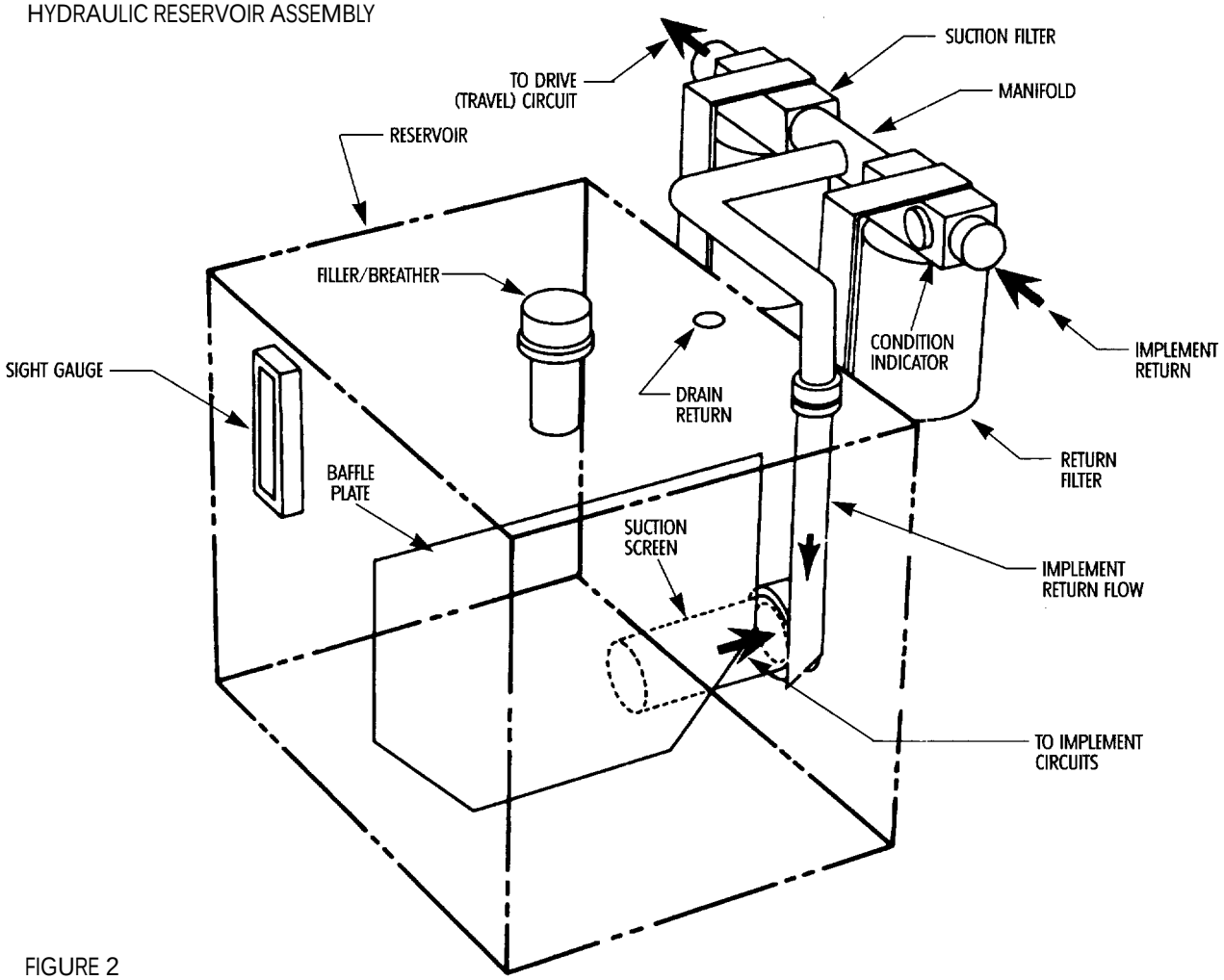
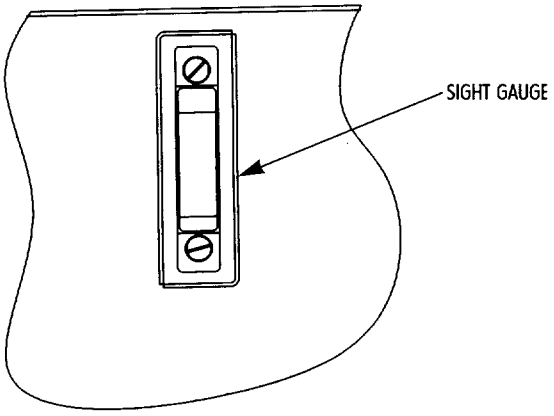


FIGURE 2
SIGHT GAUGE



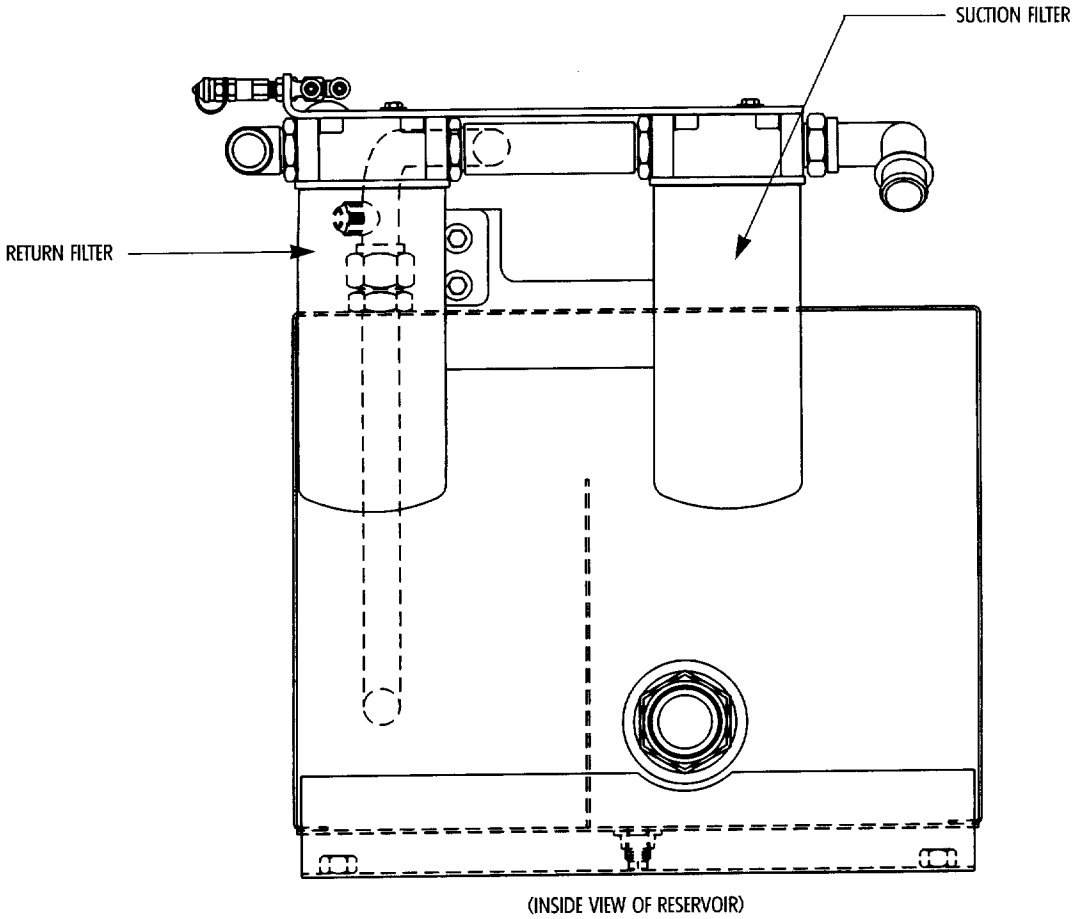
II. Hydraulic Filter Condition

Reason for Hydraulic Filter Condition Check
Dirty suction filters can restrict oil flow to the charge pump. This can lower control pressure which can affect the machine's ability to move, especially when ambient temperature is under 32°F.

Change the hydraulic filters if they have more than 1,000 hours on them. To check hydraulic filter condition, warm the hydraulic system oil to operating temperature (minimum 100°F). Check the filter restriction indicator on the return filter. The indicator should not show filter bypass with the engine at full throttle and the park brake engaged. If it shows bypass, replace the suction and return filters. Use hydraulic filter (P/N 9114-3144) for both suction and return filters. ***See Figure 3.***

Only GRADALL-supplied filters meet or exceed the filtration requirements of the drive system. If any other type of filter was installed, change it to o GRADALL filter and sample oil for condition. Failure to use GRADALL filters may void warranty.

FIGURE 3
HYDRAULIC RESERVOIR ASSEMBLY



III. Engine Speed

Reason for Engine Speed Check

Low engine RPM can reduce control pressure. Control pressure determines machine speed. This condition can slow machine speed at full RPM.

Check engine speed with an adequate tachometer. At low idle, it should be 800-900 RPM. Adjust engine speed using the screw on the injection pump. At full throttle with no load, it should be 2500-2700 RPM. When testing engine speed, make sure the injection pump lever is contacting the stop. The sealed adjustment screw on the pump is not adjustable. Please note the initial adjustment on current accelerator pedals. ***See Figure 4, Figure 5, Figure 6 and Figure 7***

FIGURE 4
ENGINE ASSEMBLY (LEFT SIDE)

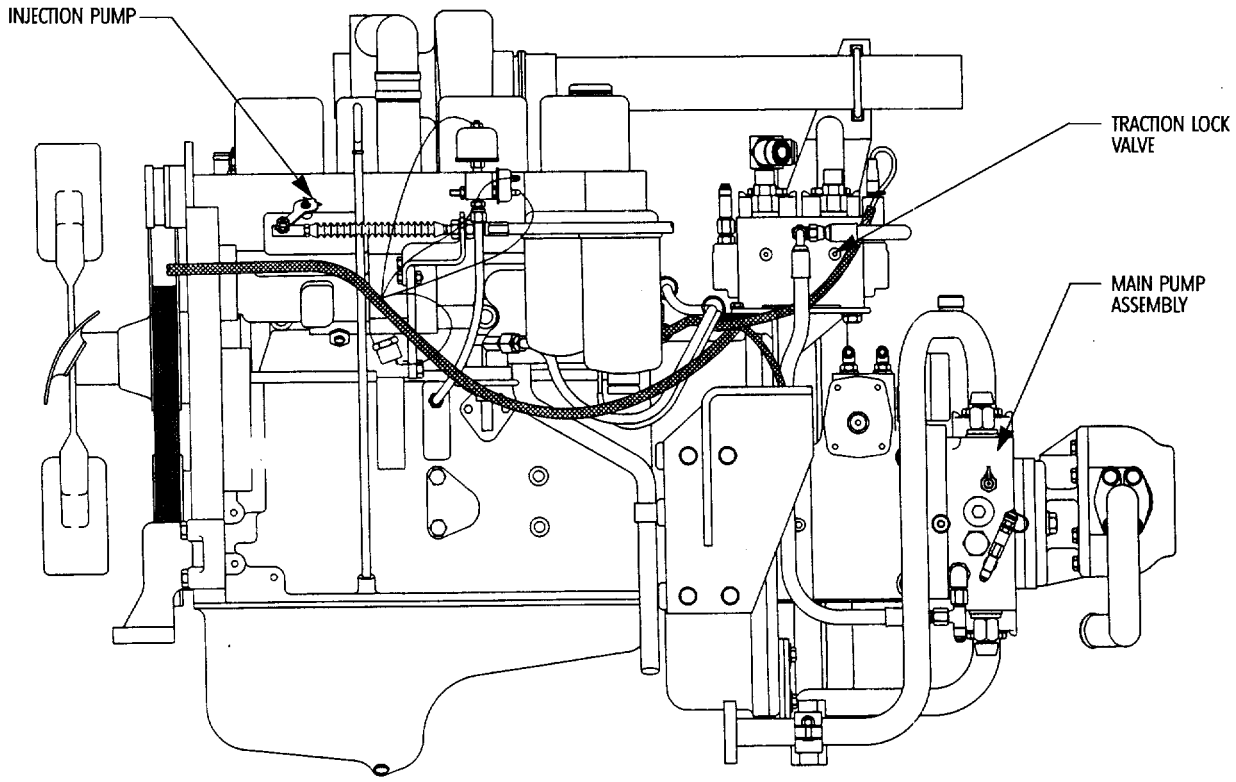


FIGURE 5
BOTTOM OF FLOOR PLATE ASSEMBLY (CURRENT)

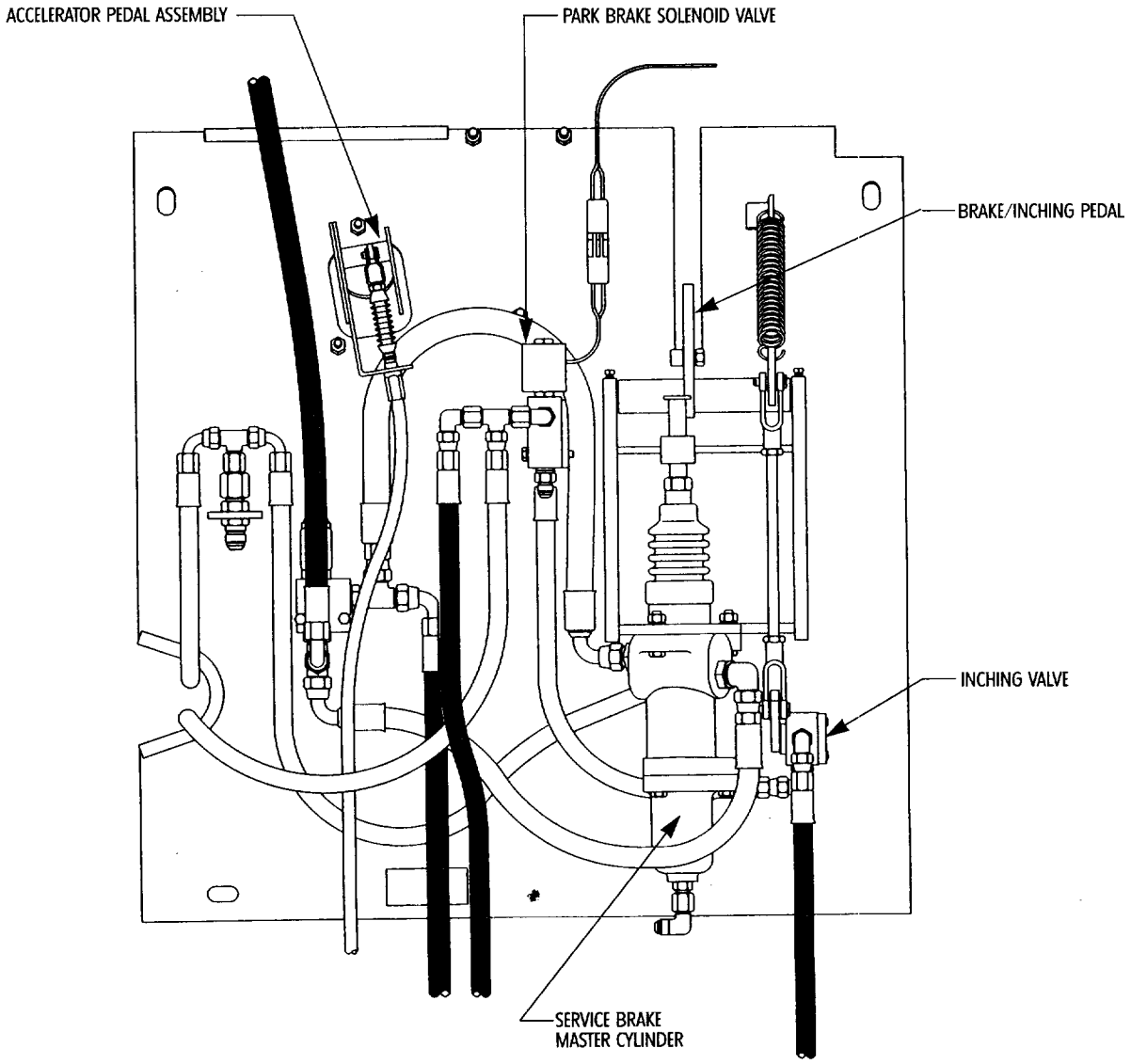


FIGURE 6
ACCELERATOR PEDAL ASSEMBLY (CURRENT)

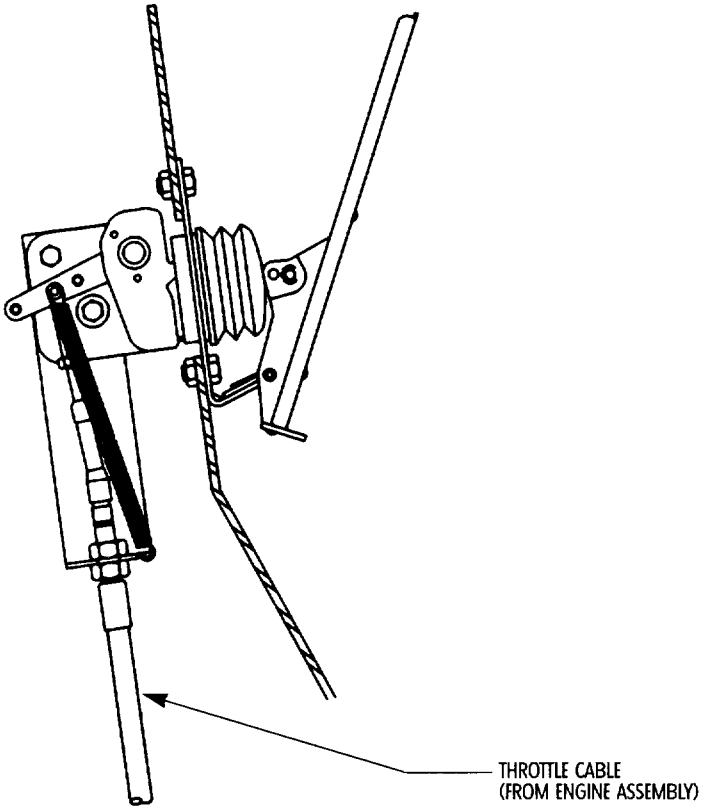
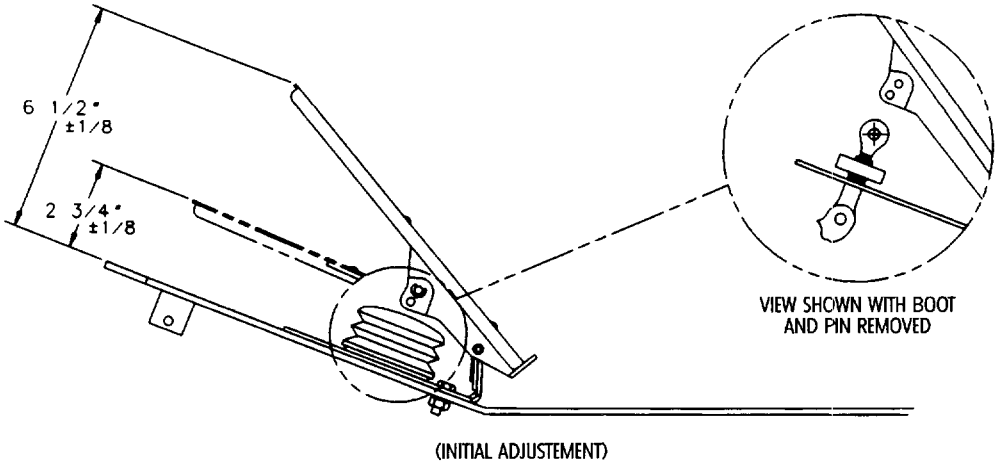


FIGURE 7
ACCELERATOR PEDAL ASSEMBLY (CURRENT)
(AUXILIARY VIEW)



IV. Park Brake

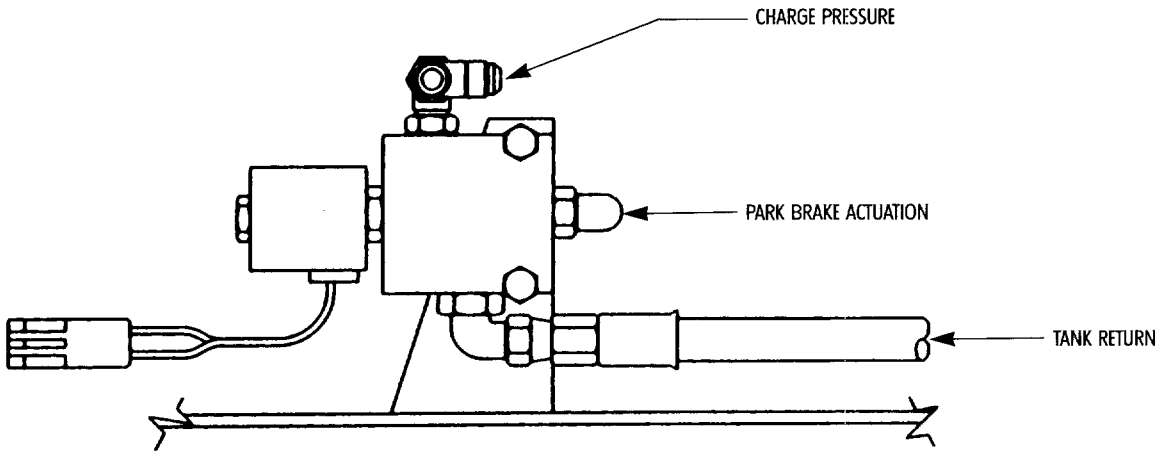
Reason for Park Brake Check
Park brake wear can cause park brake failure and reduce braking effectiveness on a slope.

With the park brake engaged, start the engine. Position the 2WD/4WD switch for two-wheel drive. With the rear wheels aligned straight ahead, move the shift lever to the forward position and run the engine full throttle (2500 RPM-2700 RPM). If the brakes are working properly, the machine will not drive through the brakes.

High backpressure in the actuation line can affect the brake holding power. To determine whether the brake is at fault, remove the brake actuation line and plug. Check the park brake operation again. If the machine does not move, the brake is working properly.

Backpressure should be less than 20 PSI with oil at operating temperature. To check this pressure, tee a low pressure gauge (1,000 PSI), hose and adapter in the brake actuation line. If it is higher, check for proper operation of the park brake solenoid valve. Disconnect the brake actuation line and tank return line at the valve and plug them. There should be no oil flowing from the open port on the park brake solenoid valve. The brake actuation line should not be kinked. There should be no restriction back to the reservoir. ***See Figure 8C.***

FIGURE 8
PARK BRAKE SOLENOID VALVE



There is a 10% wear factor on the 8 original rotor discs in the extended park brake assembly (P/N 9114-4160). Thus, the 2 “thick” discs (0.150") each have a minimum allowable thickness of 0.135". The 6 “thin” discs (0.062") each have a minimum allowable thickness of 0.056".

To remove park brake assembly, remove 4 drive motor nuts and slide motor out of the way. Take snap ring off and remove coupler. This will allow access to pinion nut. Take pinion nut off and remove park brake assembly.

Park Brake Assembly Rotor Discs

Original Thickness	No. of Discs	10% Allowable Wear Thickness
0.150"	2	0.135"
0.062"	6	0.056"

Spring free length is one inch. Anything less reduces brake holding power. Any combination of the above circumstances reduces brake holding capability. ***See Figure 8, Figure 8A, Figure 8B and Figure 8C.***
Also refer to “Page 6-6” in the **Parts Manual** (P/N 2460-4100) for breakdown of park brake assembly.

FIGURE 8A
FRONT AXLE ASSEMBLY
P/N 9114-5139

STARTING
534C-9 SERIAL NO. 0344001
534C-10 SERIAL NO. 0266001

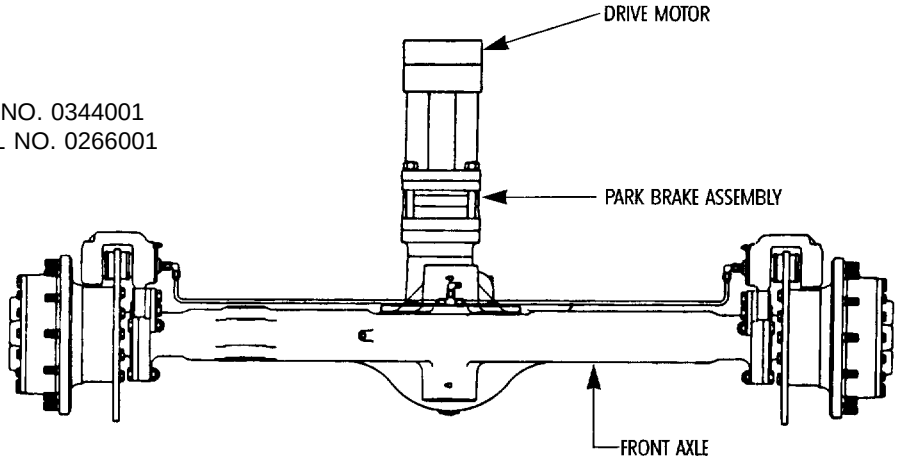


FIGURE 8B
PARK BRAKE ASSEMBLY
P/N 9114-4160

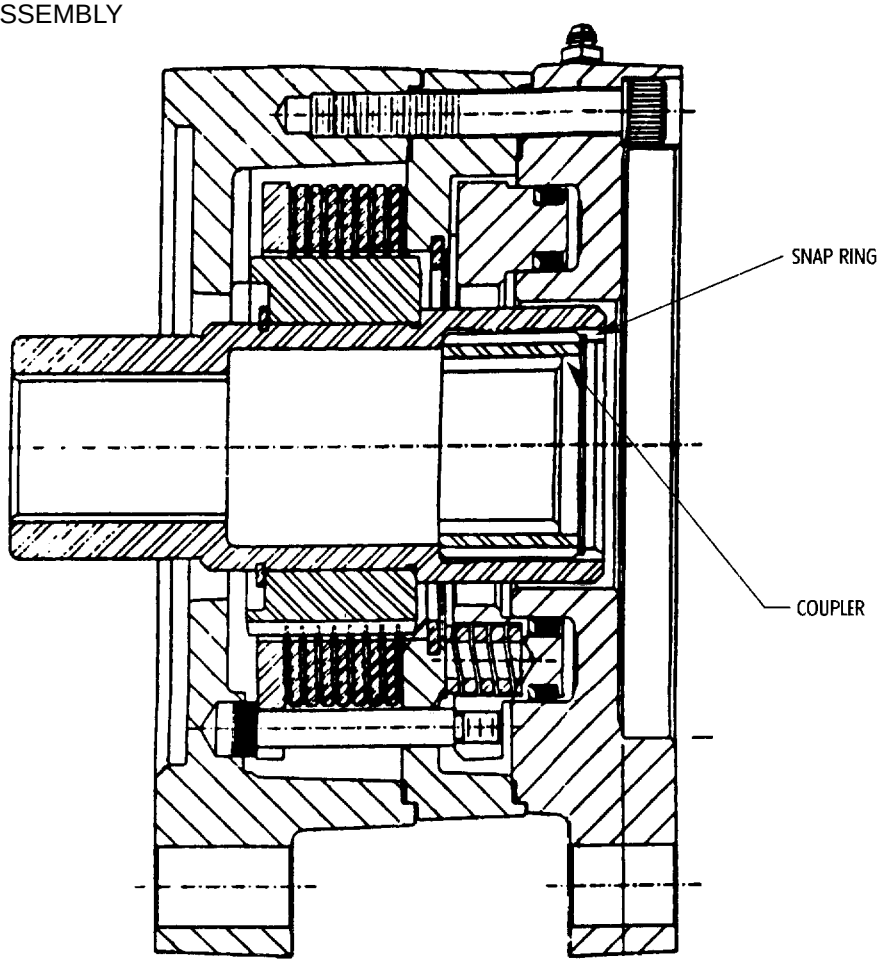
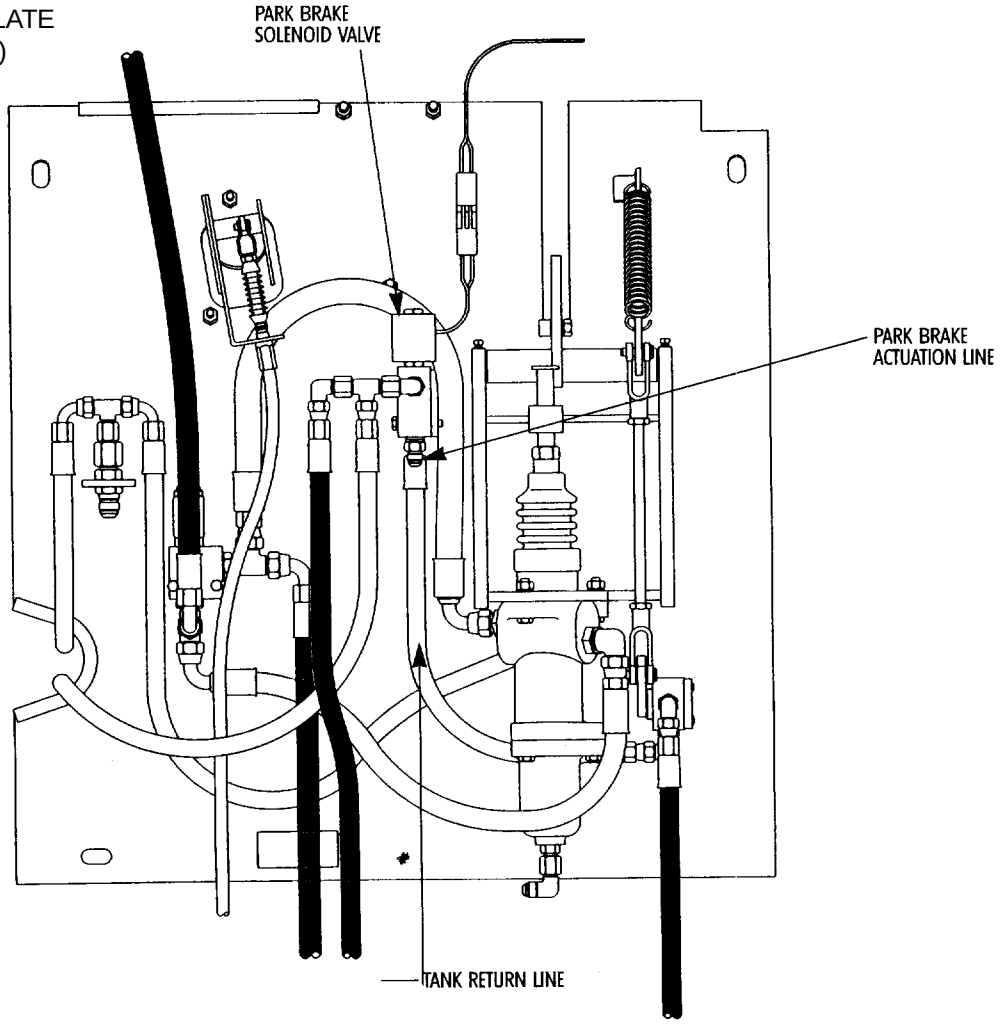


FIGURE 8C
BOTTOM OF FLOOR PLATE
ASSEMBLY (CURRENT)



A new front axle housing went into production starting 534C-9 Serial No. 0344394 and 534C-10 Serial No. 0266057. When the new front motor design went into production, several units later the front axle housing stayed the same. The park brake is internal in the front axle differential assembly. The brake test procedure remains the same. However, the park brake components are different. ***See Figure 8D.***

To check for friction disc wear, the axle must be disassembled and reassembled according to *Rockwell Maintenance Manual No. 9D*. The brake disc thickness is 0.1245". There is an 8-10% maximum wear factor allowed on the discs. The minimum disc thickness allowed is 0.1120". ***See Figure 8E.***

FIGURE 8D
FRONT AXLE ASSEMBLY
P/N 9114-3199

STARTING
534C-9 SERIAL NO. 0344394
534C-10 SERIAL NO. 0266057

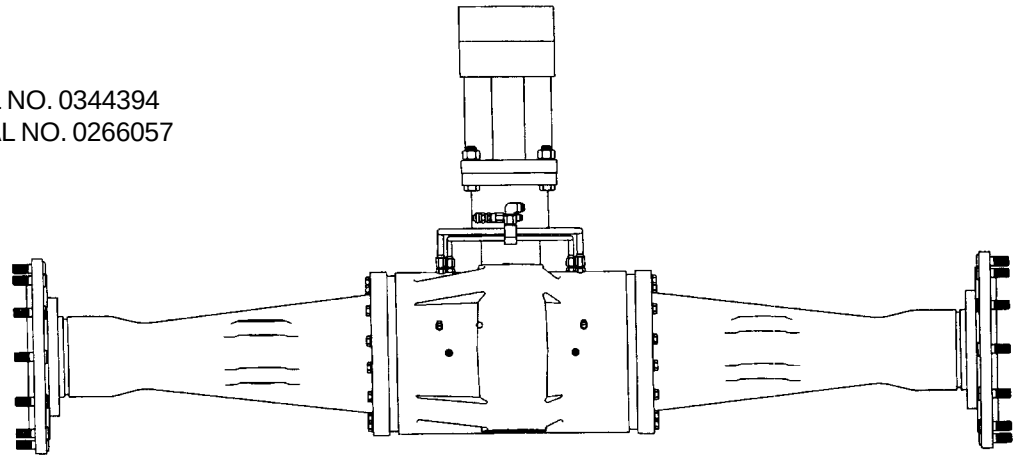
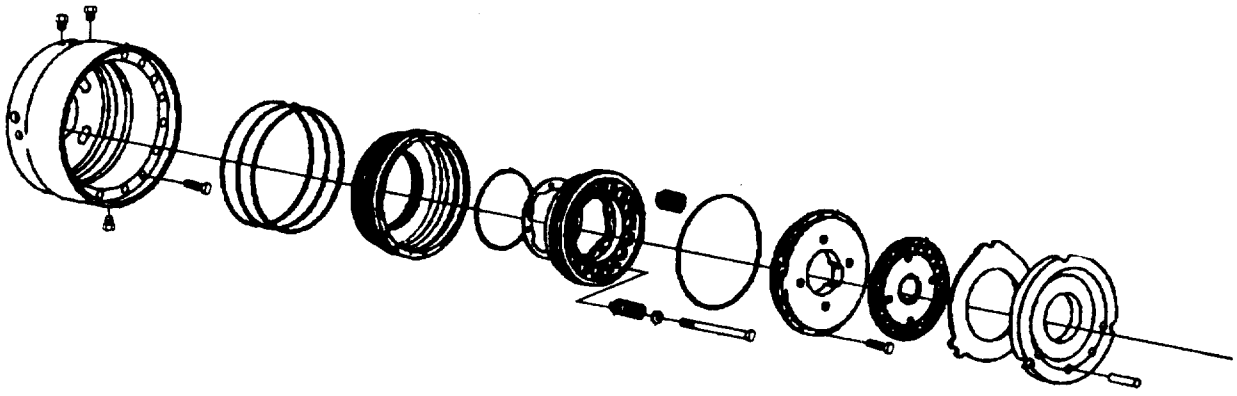


FIGURE 8E
DRIVE TRAIN BRAKE ASSEMBLY



V. Charge Pressure

Reason for Charge Pressure Check

To ensure proper park brake operation, charge pressure needs to be at proper specification. Since temperature can affect results, make certain to test system with warm oil (minimum 100°F). Control pressure is modified charge pressure. If charge pressure is low, control pressure may be low and machine speed reduced. Thus, drive performance is adversely affected by low charge pressure.

Install a low pressure gauge (1,000 PSI), hose and adapter on the charge pump test port. It locates near the front inside of the hydraulic reservoir. NOTE! Before starting, make sure the gauge can be observed in the operator's cab and apply the park brake. Start the engine and run at low idle (800-900 RPM). The gauge should read approximately 380 PSI. At full throttle (2500-2700 RPM), the gauge should read a maximum of 480 psi and never less than 380 PSI. ***See Figure 9.***

NOTE! Throughout test operation, charge pressure should not drop below 380 PSI *and* should move toward 480 PSI as RPM rises, regardless of how many functions are being operated simultaneously.

The charge pump relief (located at the left side of the main drive pump) adjusts as necessary. To adjust the charge pump relief, loosen the locknut and turn the adjusting screw clockwise to increase charge pressure; turn counterclockwise to decrease charge pressure. Be sure to note the amount that the relief turns in either direction. When finished, tighten the locknut and install a blue plastic cap.

To pinpoint the loss of charge pressure, start at the pump. Make sure the machine is in 4WD when testing rear motors. Remove the hose from the G port (charge pump output port) on the pump, install a low pressure gauge (1,000 PSI) on the fitting and plug the hose. Check the charge pressure again and observe the gauge. If the charge pressure comes back to specifications, the loss of pressure is in one of the auxiliary valves. These valves include the 2WD/4WD valve, traction lock valve, park brake solenoid valve and the joystick. Isolate each of these valves to check for the loss of charge pressure. ***See Figure 10.***

Another test to determine the loss of charge pressure is to cap off lines to the drive motors. Reinstall hoses from previous test. Install low pressure gauge (1,000 PSI) on the charge pressure test port. Check each motor separately. Start at the left rear motor. Remove the hoses to the motor at the tubes and plug with ORS #12 plugs (P/N 8471-4002). Cap motor work ports also to prevent dirt from entering the motor with ORS #12 caps (P/N 8471-4006). Start the machine and observe the gauge for charge pressure. Engage drive forward and reverse against the park brake and observe gauge for charge pressure simultaneously. Record the findings. If charge pressure recovers, the motor is defective.If charge pressure does not recover, repeat test for right rear motor. ***See Figure 11.***

Isolate the front drive motor from the circuit if the rear motors are not defective. To isolate it will require two blocking plates (P/N 9108-1667). Install these plates between the front drive motor work ports and the drive hoses. Remove the flange halves and place the blocking plates on the ports and reinstall the hoses and flanges. Again, start the machine and observe the pressure gauge for charge pressure. If the charge pressure recovers, the motor is defective. To confirm, check charge pressure with drive against the park brake. Charge pressure should remain at 380 PSI. ***See Figure 11A.***

The charge pump efficiency also needs to be checked if the previous tests prove inconclusive. Check charge pump flow out of T1 port on the side of the pump. ***(See Figure 12).*** At 850 RPM, there should be 4 GPM. At 2500 RPM, there should be 12 GPM of flow. Disconnect run tee and plug. Measure charge pump flow out of fitting against above specification. The flow readings are checked at 480 psi. If the test is positive on flow, proceed to the next step.

To check internal leakage of the main pump, block off ports A and B at the main pump. If drive motors have already been isolated, continue testing. Install two high pressure (10,000 PSI) gauges, hoses and adapters in drive pump ports MA and MB. Start machine and operate at low idle. If the pump is good, pressure at MA and MB test ports should read 380 PSI. Adjust relief valve to see if pressure responds. Engage forward drive with park brake set, raise engine speed to full throttle and record drive pressure and charge pressure. Repeat this procedure for reverse. Drive pressure should be 6300 PSI in each direction. Charge pressure should remain at 380 PSI and rise to approximately 480 PSI near full throttle. If charge pressure is not achieved, main pump is leaking internally. ***See Figure 12.***

NOTE! Do not stall pump for more than 15 seconds each time.

FIGURE 9
CHARGE PRESSURE
TEST PORT

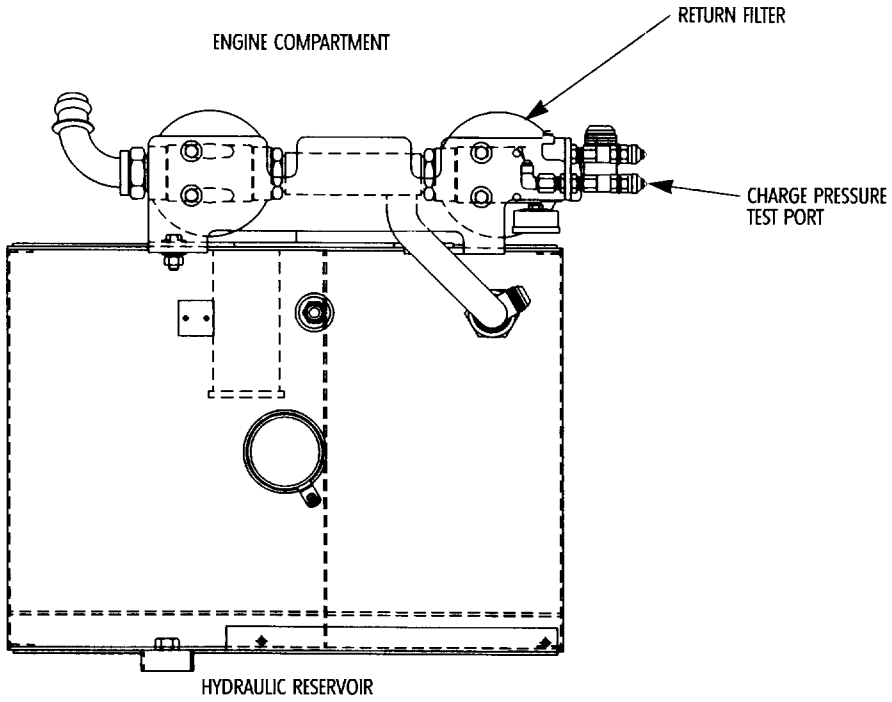


FIGURE 10
MAIN PUMP ASSEMBLY (SIDE VIEW)

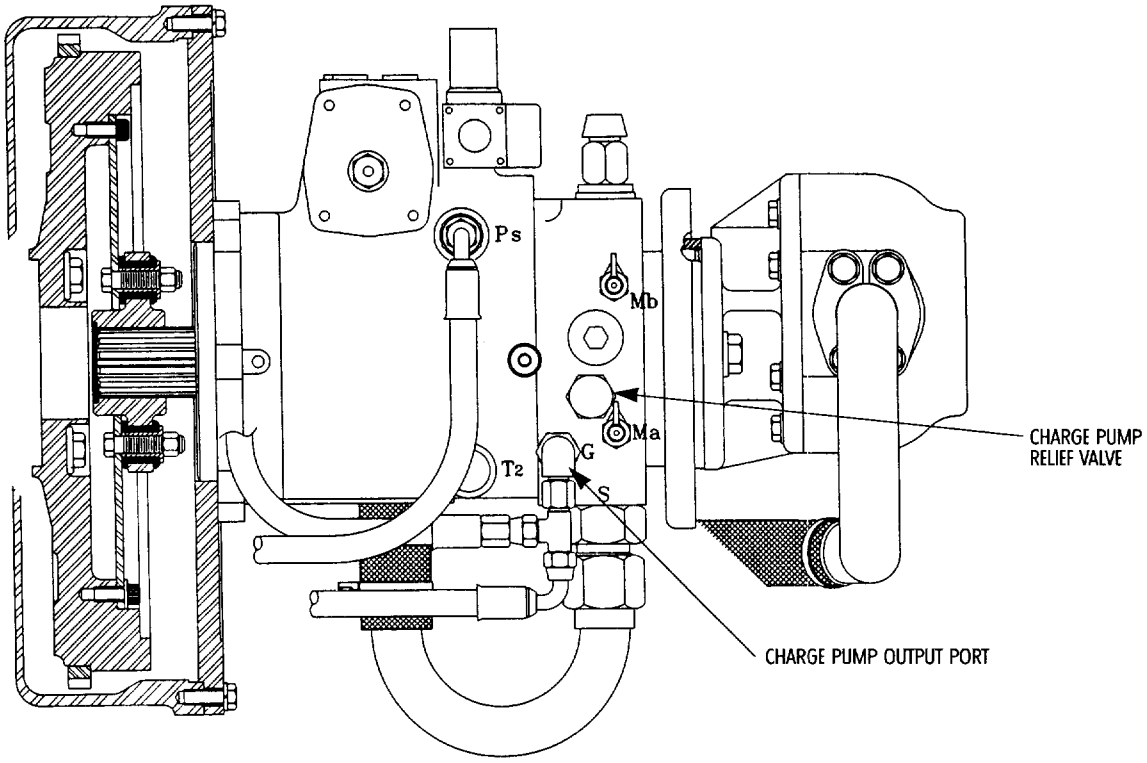


FIGURE 11
REAR DRIVE MOTOR ASSEMBLIES (MOUNTED)

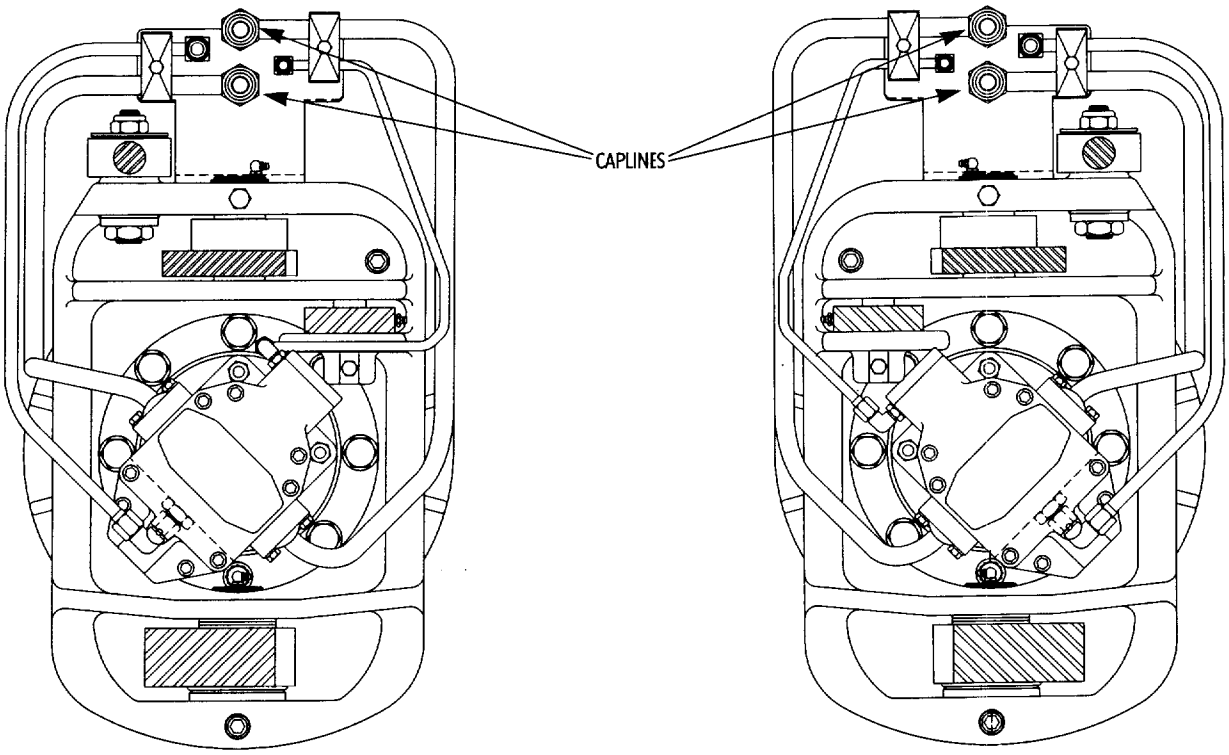


FIGURE 11A
FRONT DRIVE MOTOR (SIDE VIEW)

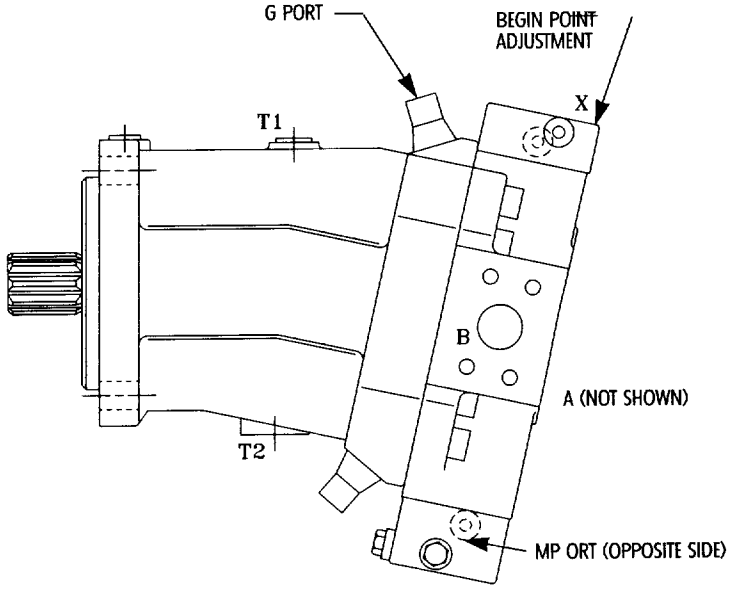
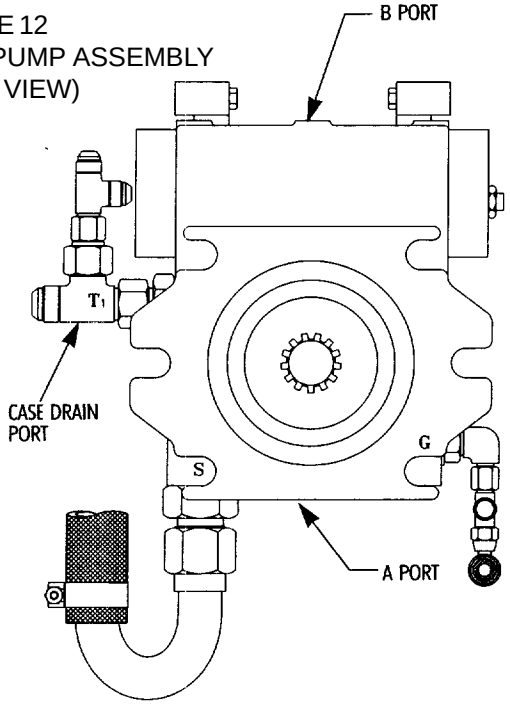


FIGURE 12
MAIN PUMP ASSEMBLY
(REAR VIEW)



VI. Control Pressure

Reason for Control Pressure Check

To ensure control pressure is correct for proper machine speed. For the machine to move at proper engine speed, control pressure should match engine RPM.

Install a low pressure gauge (1,000 PSI), hose and adapter on the drive pump control pressure Ps port. Remove the hose from port and plug. NOTE! Before starting, make sure the gauge can be observed in the operator's cab and apply the park brake. Start the engine and run at full throttle speed (2500-2700 RPM). With the pump in neutral, the gauge should read 380 PSI. This may vary +/- 15 PSI. ***(See Figure 13).***

Use a tachometer to monitor engine speed. Start the engine and run at 1100 RPM. While watching the pressure gauge, move the shift lever to the forward position. The gauge should read 100 PSI. Next repeat the test for reverse. If the machine does not start to move at 1100 RPM engine speed in both directions equally at 100 PSI control pressure, the stroking piston needs centered mechanically.

To check this adjustment, install a clean hose between control ports X1 and X2. They are lotated on the top of the drive pump. ***See Figure 14.*** Remove and plug control hoses from the top of the drive pump ports X1 and X2. Install two high pressure (10,000 PSI) gauges, hoses and adapters in the drive pump ports MA and MB on the side of the pump. Start the engine and operate at low idle. Observe the gauges. Pressure at MA port must be equal to the pressure at MB port. If pressures are not equal, loosen locknut on stroking piston adjustment and turn adjusting screw to equalize pressures. Tighten locknut to secure adjustment. Repeat this procedure with low pressure (1,000 PSI) gauges to fine tune.

If the inching valve and forward/reverse valve work correctly but adjustment does not produce the desired pressure change, replace the control pressure (DA) cartridge located on the left of the drive pump.

FIGURE 13
MAIN PUMP ASSEMBLY (SIDE VIEW)

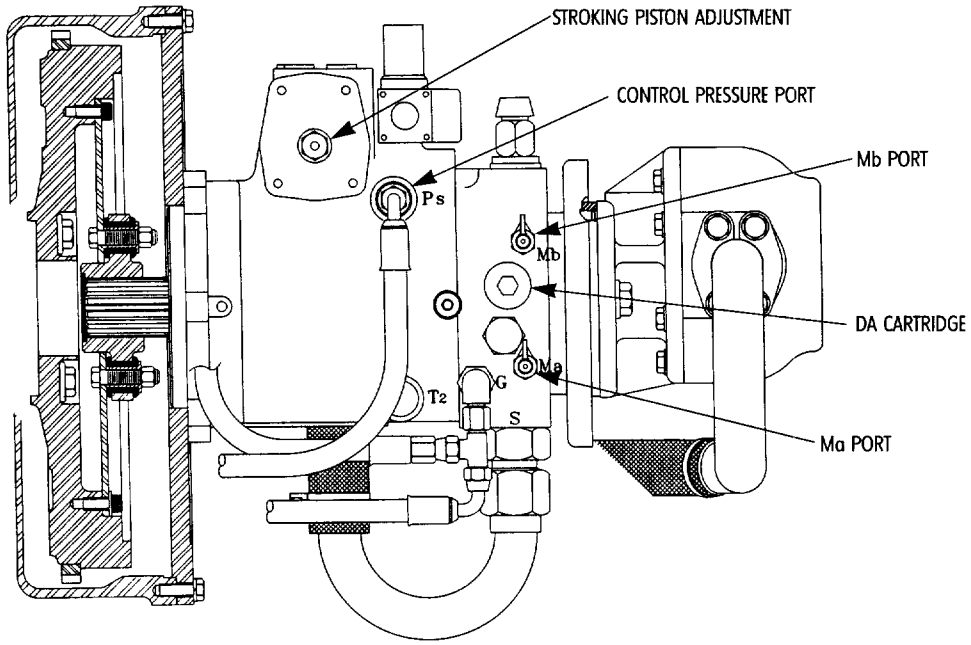
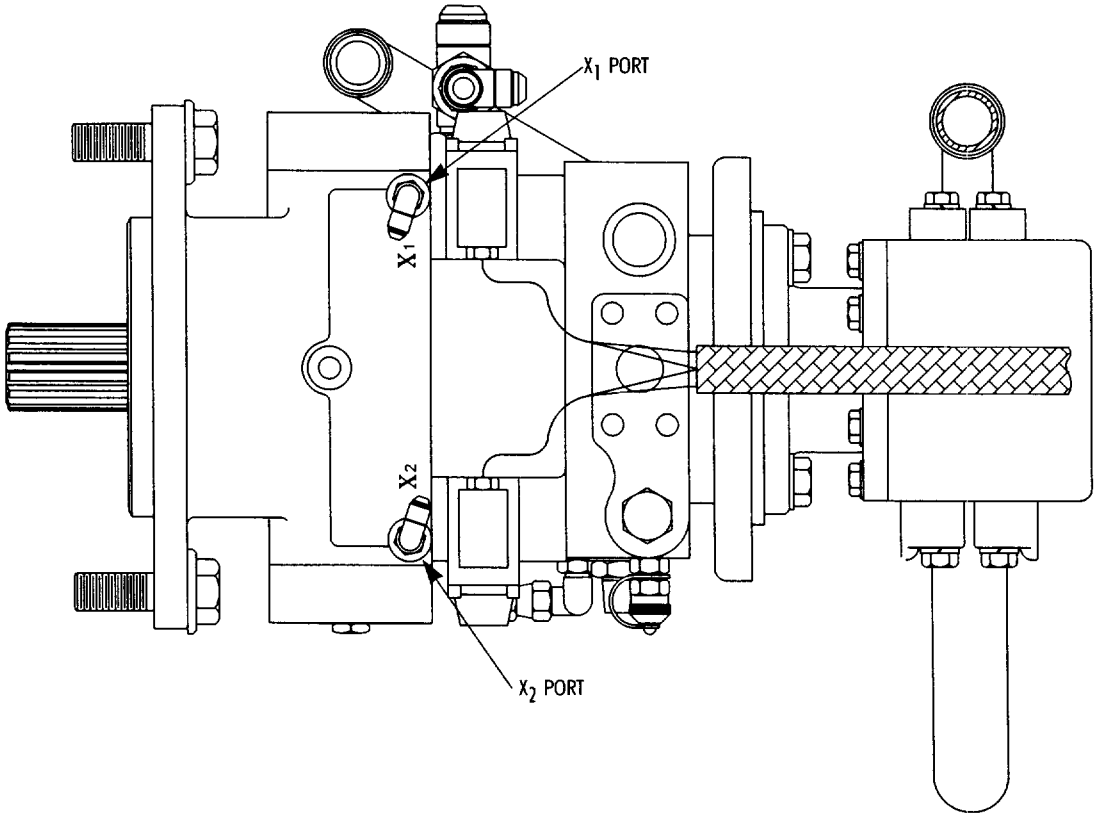


FIGURE 14
MAIN PUMP ASSEMBLY (TOP VIEW)



VII. Inching

Reason for Inching Check

Loss of control pressure can affect machine speed.

A low pressure gauge (1,000 PSI), hose, # 6 run tee and adapter should be teed into the Ps port on the drive pump. Apply the park brake and run the engine at full throttle (2500-2700 RPM). The gauge reading should be the same as in the previous control pressure test. Depress the brake pedal. The control pressure should start to fall after one-half inch of pedal travel. This pressure should drop as the pedal travels farther and the service brakes apply. The controlled linkage length should be 12-1/4 inches from the centerline of the yoke pins. The lever arm position on the inching valve should set 1/8 inch off the pin as a starting point.
See Figure 16 and Figure 17.

Another check for the inching adjustment is to install a high pressure gauge (10,000 PSI), hose and adapter on MA port on the drive pump. With the park brake on, move the shift lever to the forward position. At full throttle, depress the inching/brake pedal slowly. When the roller on the pedal just touches the brake valve plunger, the gauge should read 2,300 PSI +/- 100. ***See Figure 15.***

FIGURE 15
MAIN PUMP ASSEMBLY (SIDE VIEW)

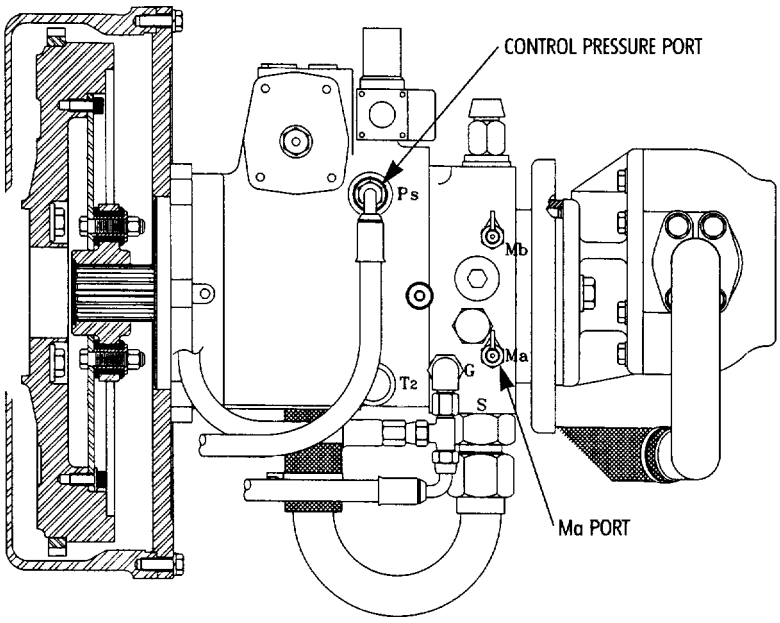


FIGURE 16
FLOOR PLATE ASSEMBLY

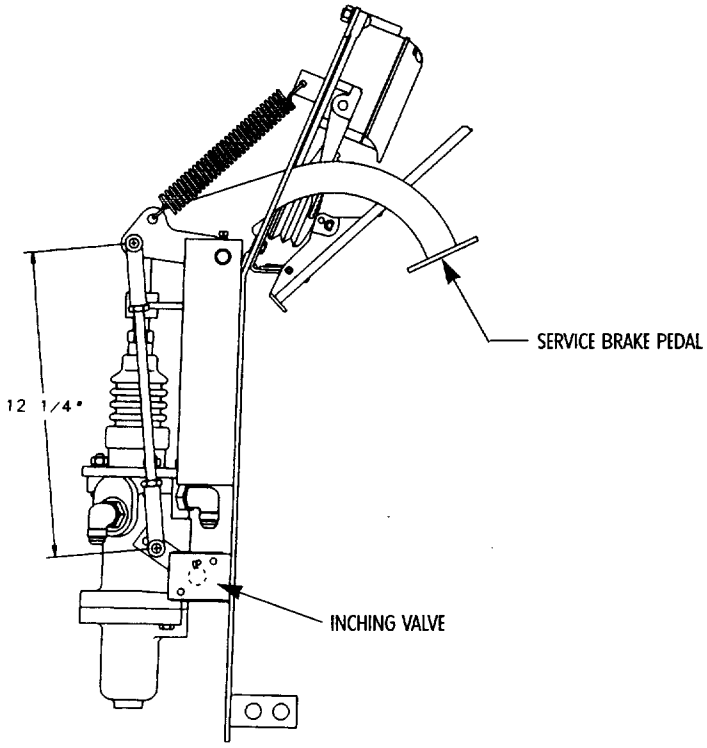
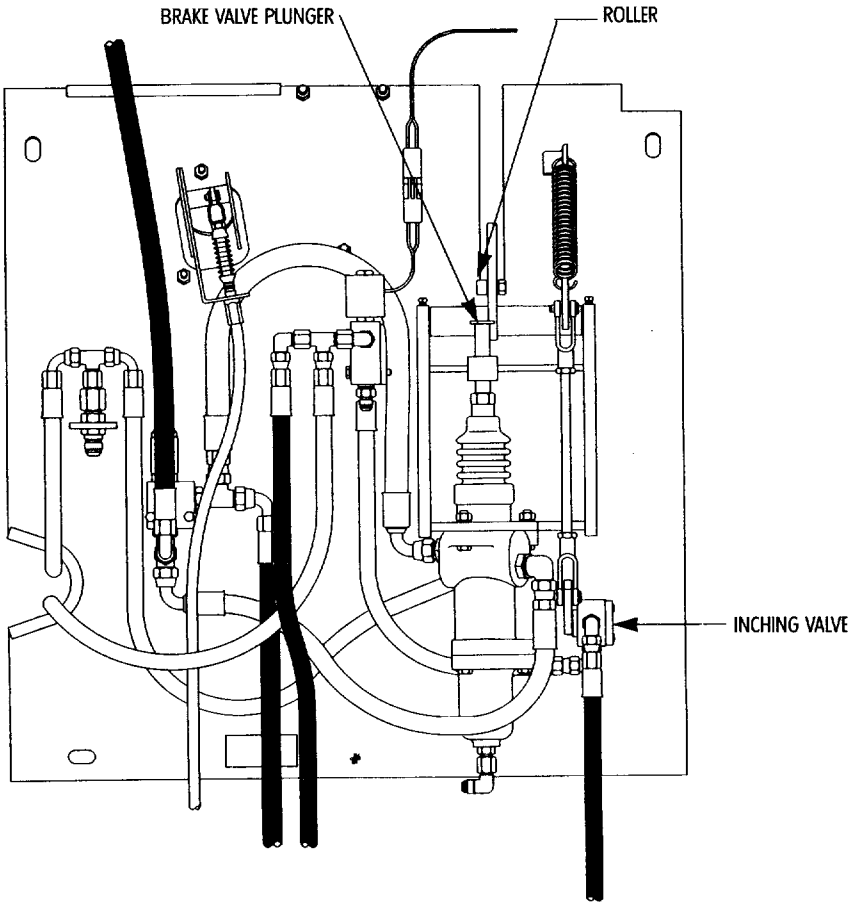


FIGURE 17



VIII. Front Motor Begin Point

Definition: The point at which the front motor begins to stroke toward minimum displacement.

Reason for Front Motor Begin Point Check
Without proper adjustment, machine speed on a flat, smooth surface will not meet specifications. The motor may not be shifting to a maximum speed position.

Install a high pressure gauge (10,000 PSI), hose and adapter on MB port on the drive pump. Adjust the reverse high pressure relief valve to 3,300 PSI by loosening the locknut. The reverse high pressure port relief is on the top left of the pump. Install adopter, test port (P/N 7713-3089), #6 run tee and low pressure gauge (1,000 PSI) into the Ps port of the pump. (Ps port is connection for the inching valve hose). Set the parking brake and block the tires to prevent movement of the machine. Machine should be in 2WD. Shut off the machine. Remove plugs from G and M ports of the front drive motor. G port is found at the bottom of the front drive motor controls. M port locates at the top left side of the controls. ***See Figure 18 and Figure 19***. Install test ports (P/N 7713-3089) in place of the plugs. Attach a high pressure gauge (10,000 PSI) to both test ports.

WARNING During the next two steps, to prevent excessive heat in the hydraulic oil and possible damage to hydraulic components, do not operate for more than 30 seconds at a time.

Start engine and raise RPM until gauge on Ps port is at 240 PSI. Maintain this RPM and pressure throughout the test. With pressure on Ps port at 240 PSI, the pressure at G port should read 3,300 PSI. Adjust “begin” point screw on the motor so that M port on motor sees opproximately 1,650 PSI. (NOTE! Begin point screw adjustment is very sensitive.) NOTE! The pressure on M port will not be steady. This is the pressure that shifts the motor to maintain minimum displacement.

Under normal operating conditions, the 3,300 PSI on G port required to shift the motor will not be constant. When this pressure is reached, the motor shifts. Since the pressure supplied is constant, the motor will not stay in a partially shifted position. Reset the reverse high pressure relief valve to 6,800 PSI. Use procedure # 9 drive pump pressure to adjust this relief.

Wrench sizes required: 4mm allen and 10mm box.

FIGURE 18
MAIN PUMP ASSEMBLY (SIDE VIEW)

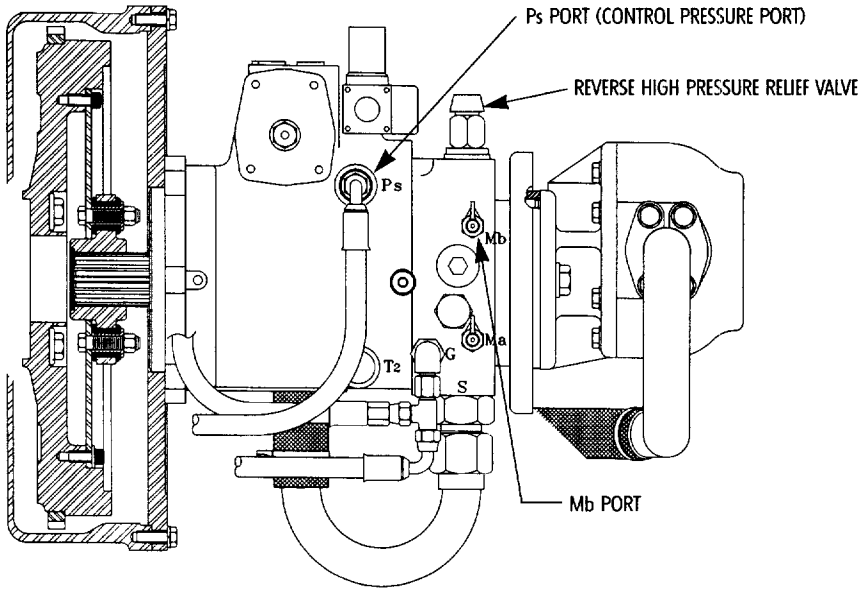
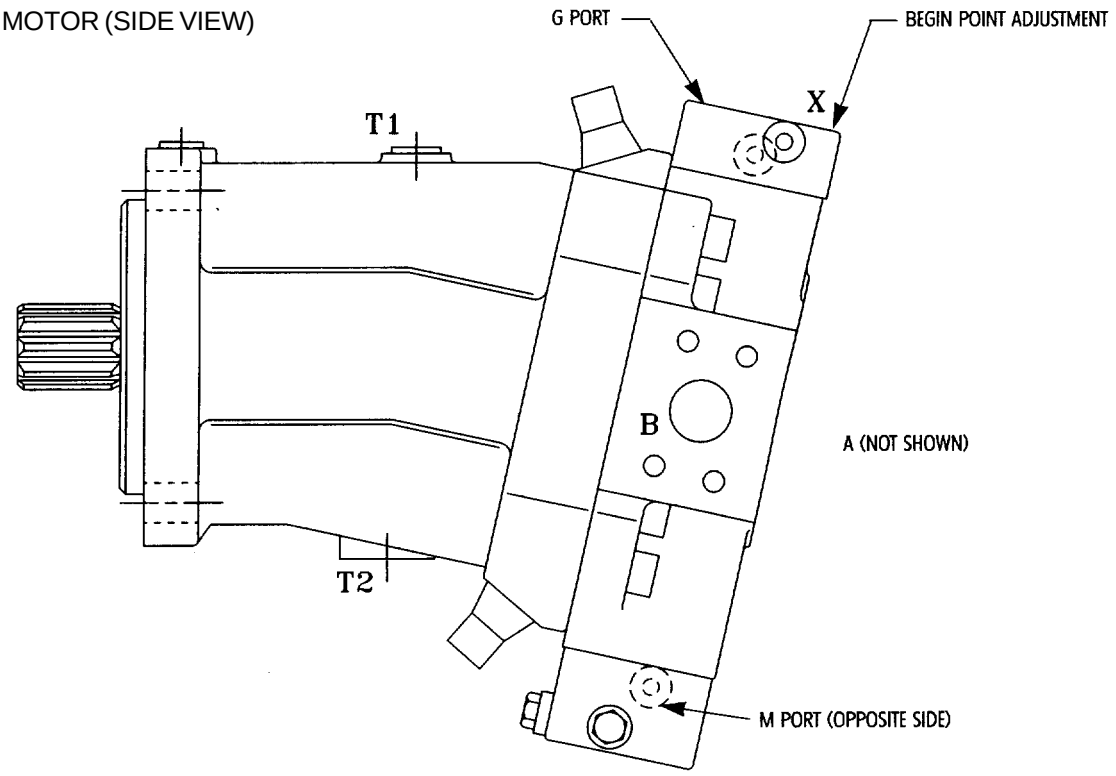


FIGURE 19
FRONT DRIVE MOTOR (SIDE VIEW)



For our application, this drive motor is utilized in a 180 degree inversion.

IX. Drive Pump Pressure

Reason for Drive Pump Pressure Check
Drive pump pressure determines the drive power of the machine. Low drive pressure will result in less power.

Install a high pressure gauge (10,000 PSI), hose and adapter on the MA port (located at the bottom of the drive pump). Apply the park brake and put the 2WD/4WD switch in the 2WD position. Move the shift lever to the forward position and run the engine at full throttle (2500-2700 RPM). The gauge reading should be 6,300 PSI. Adjust the POR valve located on top of the pump as necessary. To adjust this relief valve, loosen the lock-nut and turn the adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure. Move the gauge to the MB port of the drive pump to repeat the procedure with the shift lever in the reverse position. ***See Figure 20 and Figure 20A.***

There are also high pressure/anti-cavitation relief valves on the drive pump. These could influence drive system pressure with a low setting or missing O-ring. On machines with 6,300 PSI drive pressure, adjust these valves to 6,800 PSI. Normally, these high pressure relief valves do not require checking. However, if there is a drive power problem and adjustment of the POR valve on the main pump does not change the pressure, these valves may have to be adjusted. Install a high pressure (10,000 PSI) gauge hose and adapter on MA port on the pump. To check these high pressure relief valves, raise the setting on the POR valve on the drive pump. Loosen locknut on POR valve and turn the adjusting screw clockwise one turn to increase pressure. With a high pressure gauge (10,000 PSI) hose and adapter on MA port, set the park brake, put the shifter in forward and run engine at full throttle. Adjust the forward high pressure relief to 6,800 PSI. The forward high pressure relief valve is on the bottom of the pump. Install the high pressure gauge (10,000 PSI), hose and adapter on the MB port and repeat the procedure for reverse. Adjust the reverse high pressure relief to 6,800 PSI. The reverse high pressure relief valve locates on top of the pump. Leave high pressure gauge (10,000 PSI) hose and adapter on MB port. Reset the POR back to original position. With park brake on, put the shifter in reverse and run engine at full throttle. The pressure should be 6,300 PSI. Adjust POR valve as required. ***See Figure 20 and Figure 20A.***

The traction lock valve also has two high-pressure/anti-cavitation relief valves. Normally, these require no adjustment. However, they can adversely affect drive system pressure if, say, they are set too low, or an O-ring is missing. To check these valves, raise the POR valve pressure setting above 6,800 PSI. Set the forward high pressure relief valve on the pump to 6,800 PSI. Then lower the forward high pressure relief valve on the traction lock valve under 6,800 PSI. Turn the valve in 1/8 turn and secure locknut. Repeat the procedure for reverse. Then reset the POR valve to 6,300 PSI. ***See Figure 21.***

FIGURE 20
MAIN PUMP ASSEMBLY
(SIDE VIEW)

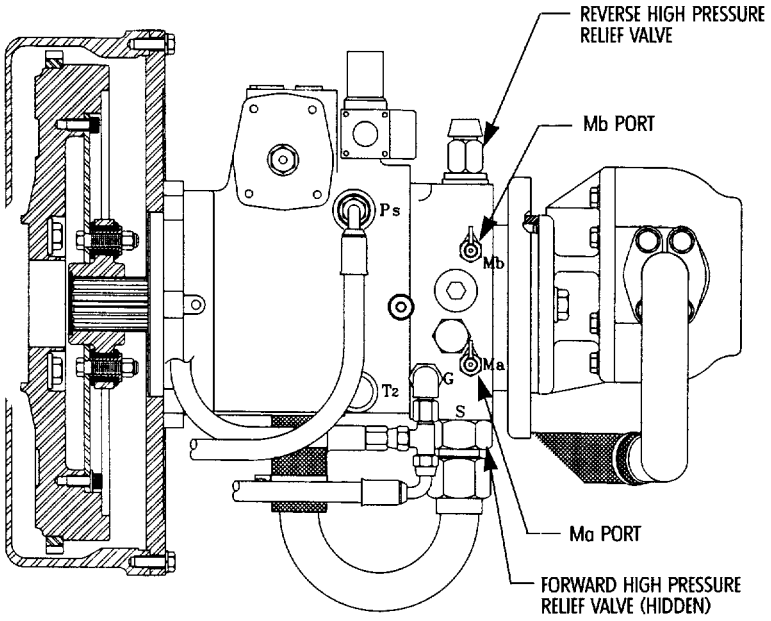


FIGURE 20A
MAIN PUMP ASSEMBLY (TOP VIEW)

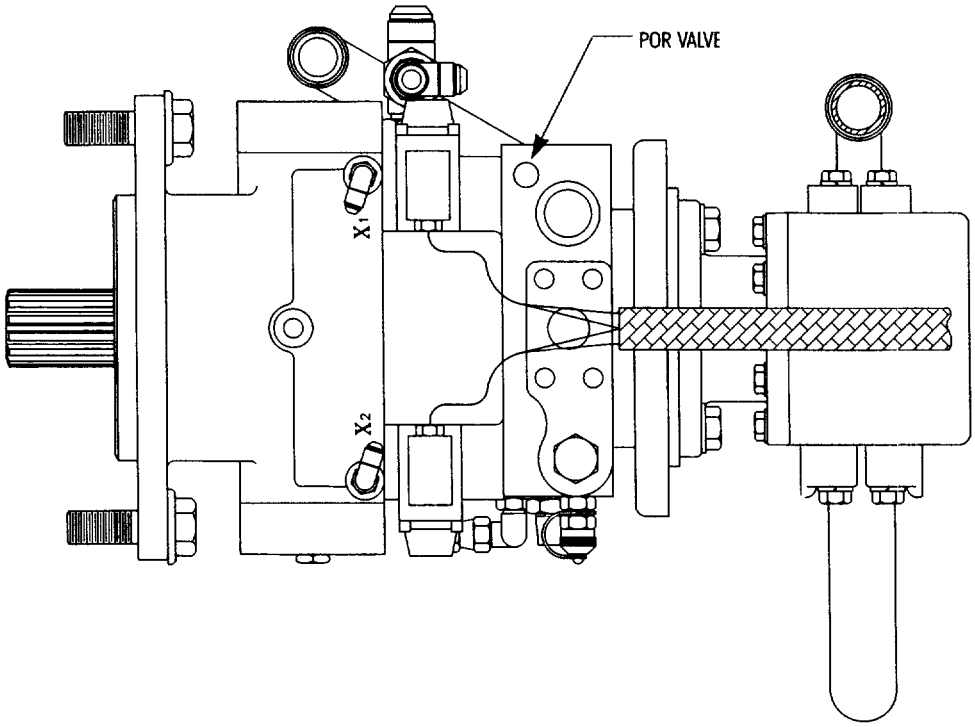


FIGURE 21
TRACTION LOCK VALVE

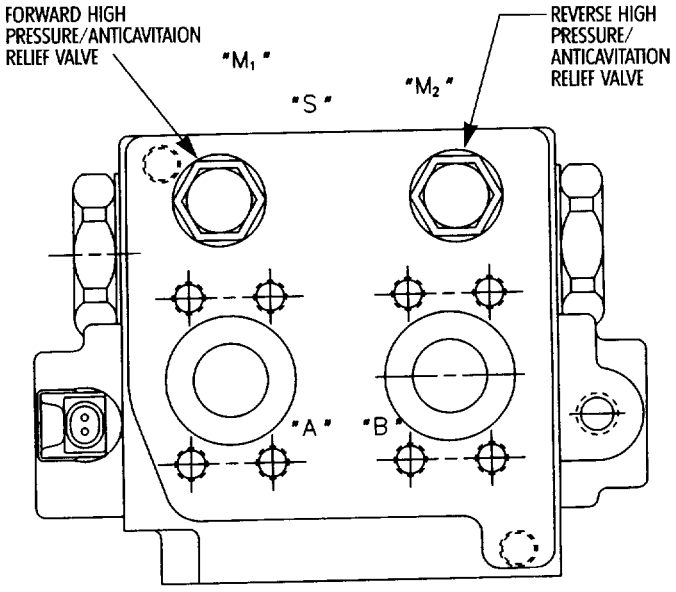
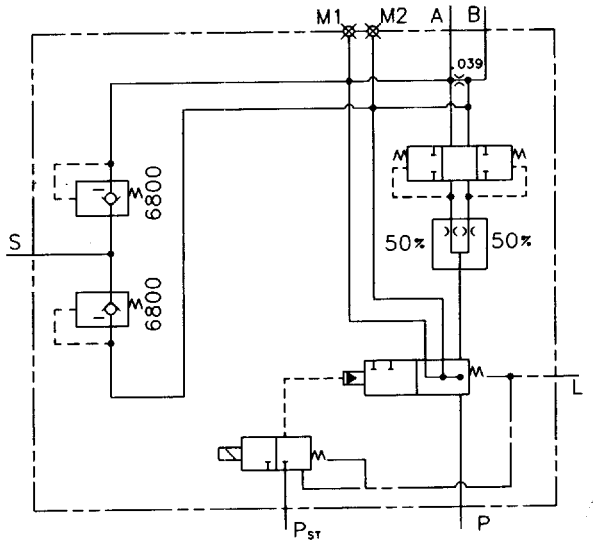


FIGURE 22
TRACTION LOCK VALVE SCHEMATIC



X. Machine Operation

Reason for Machine Operation Check

To ensure that the traction lock valve is operating correctly. Also to check for proper operation of the 2WD/4WD solenoid valve and proper begin point adjustment on the front motor.

After completion of these checks, operate the machine in a flat, smooth open area. Set the machine for 4WD operation. Depress the traction lock switch. Drive the machine at full speed. Release the traction lock switch; the machine should pick up speed. Shift the machine to 2WD and repeat this test. The machine should pick up speed again. If maximum speeds are in question, check machine speed. Run the machine in 2WD and 4WD in forward and reverse at maximum RPM for one minute. In 2WD, the machine will go 100 feet in 3.6-4.0 seconds. In 4WD, the machine will go 100 feet in 10.6-11.6 seconds. The machine must be traveling at full speed at the start of the measured distance.

CALIFORNIA

Proposition 65 Warning

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Wash hands after handling.

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Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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PRA 352 Series Planetary Axles

Maintenance Manual No. 9D

Planetary Axle Models
- PRA 352 W2H
- PRA 352 G2H
- PRA 352 G2M
- PRA 353 G2H
- PRA 353 G2M
- PRA 383 G2H
- PROA 352 W2H
- PROA 382 W2H

Service Notes

This publication provides maintenance and service procedures for Meritor PRA 352 series planetary axles. The information contained in this publication was current at the time of printing and is subject to revision without notice or liability.

1. You must understand all procedures and instructions before you begin maintenance and service procedures.
2. You must follow your company's maintenance and service guidelines.
3. You must use special tools, when required, to avoid serious personal injury and damage to components.

Meritor uses the following notations to alert the user of possible safety issues and to provide information that will help to prevent damage to equipment and components.

WARNING

A WARNING indicates a procedure that you must follow exactly to avoid serious personal injury.

CAUTION

A CAUTION indicates a procedure that you must follow exactly to avoid damaging equipment or components. Serious personal injury can also occur.

NOTE: A NOTE indicates an operation, procedure or instruction that is important for proper service. A NOTE can also supply information that can help to make service quicker and easier.

This symbol indicates that fasteners must be tightened to a specific torque value.

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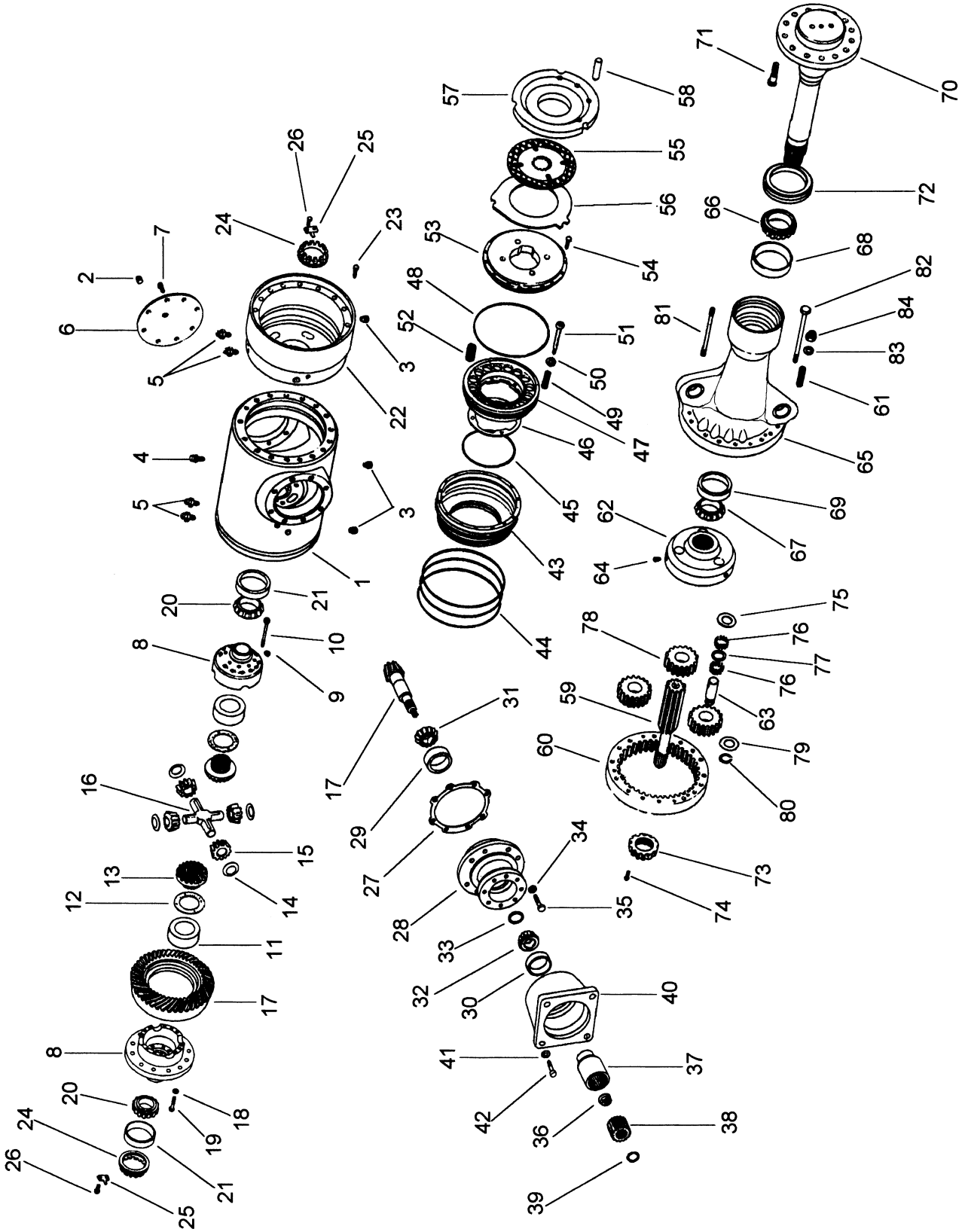
The CD includes product and service information on Meritor's Drivetrain Plus™ component lineup. $20. Order TP-9853.

How to Order

Call Meritor's Customer Service Center at 800-535-5560.

PRA 352 – Trumpet Variation No. 1

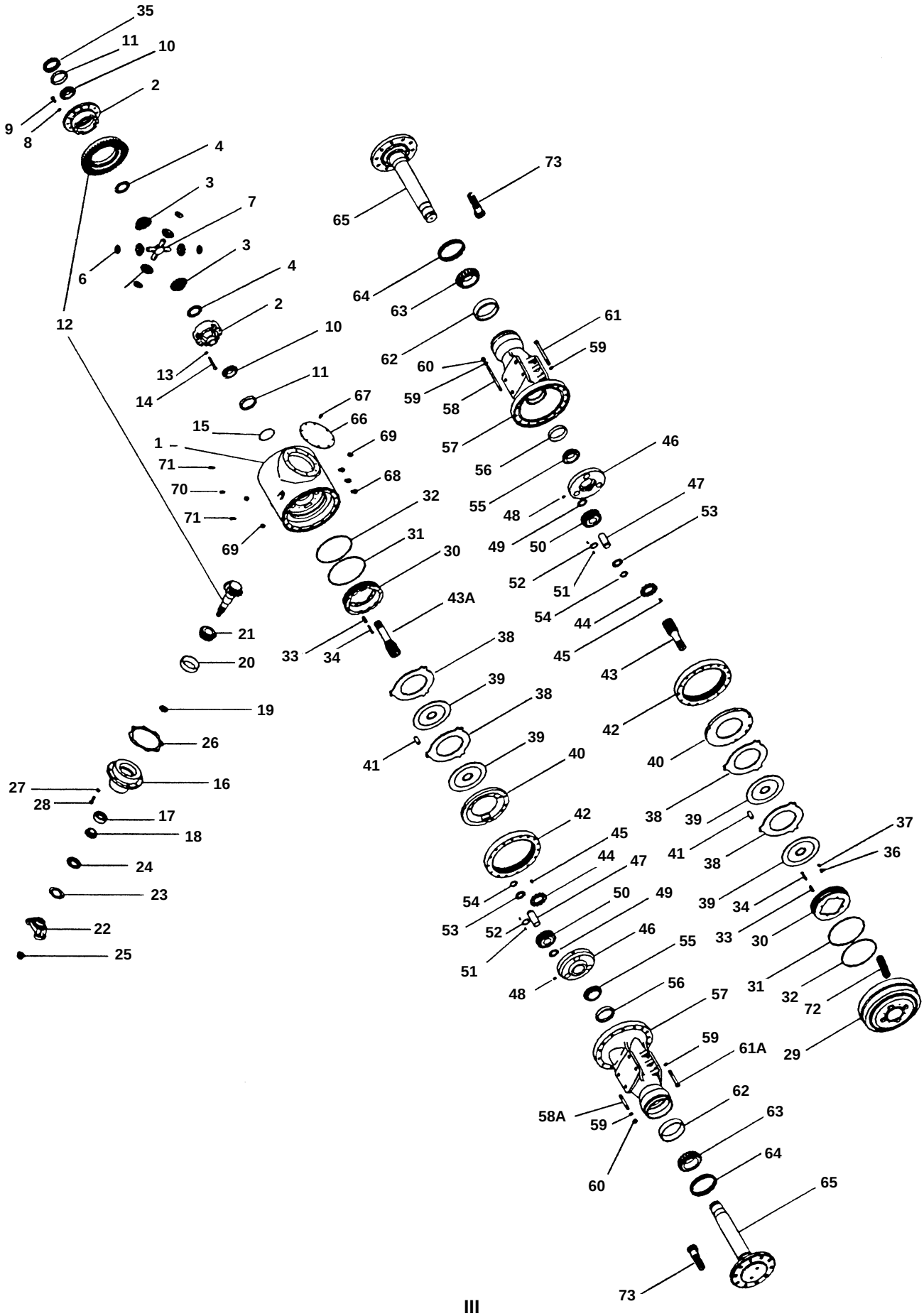


PRA 352 – Trumpet Variation No. 1

Item	Description
1	Central Housing
2	Level Plug
3	Drain Plug
4	Vent Plug
5	Hydraulic Line Bleeder
6	Cover
7	Capscrew
8	Differential Case Assembly
9	Washer
10	Capscrew
11	Spacer
12	Thrust Washer
13	Side Gear
14	Thrust Washer
15	Pinion Gear
16	Spider
17	Spiral Gear & Pinion
18	Washer
19	Capscrew
20	Bearing Cone
21	Bearing Cup
22	Brake Housing
23	Capscrew
24	Adjuster Ring
25	Adjuster Ring Lock
26	Capscrew
27	Pinion Cage Shim
28	Pinion Cage Assembly
29	Bearing Cup
30	Bearing Cup
31	Bearing Cone
32	Bearing Cone
33	Drive Pinion Shim
34	Washer
35	Capscrew
36	Pinion Nut
37	Driven Sleeve
38	Drive Sleeve
39	Snap Ring
40	Motor Adapter Flange
41	Washer
42	Capscrew

Item	Description
43	Outer Piston
44	Piston O-ring
45	Piston O-ring
46	Piston Brake Shim
47	Inner Piston
48	O-ring Piston
49	Spring
50	Washer
51	Bolt–Return Spring
52	Spring
53	Brake Actuating Plate
54	Capscrew
55	Friction Disc
56	Stationary Disc
57	Brake Reaction Plate
58	Brake Disc Lock Pin
59	Sun Gear
60	Ring Gear
61	Capscrew
62	Planetary Pinion Spider
63	Planetary Pinion Shaft
64	Capscrew
65	Housing
66	Bearing Cone
67	Bearing Cone
68	Bearing Cup
69	Bearing Cup
70	Output Axle Shaft
71	Wheel Bolt
72	Axle Shaft Oil Seal
73	Adjusting Nut
74	Adjusting Nut Lock Capscrew
75	Thrust Washer
76	Kit Rollers
77	Roller Spacer
78	Planetary Pinion
79	Washer
80	Snap Ring
81	Stud
82	Capscrew
83	Washer
84	Nut

PRA 352 – Trumpet Variation No. 2

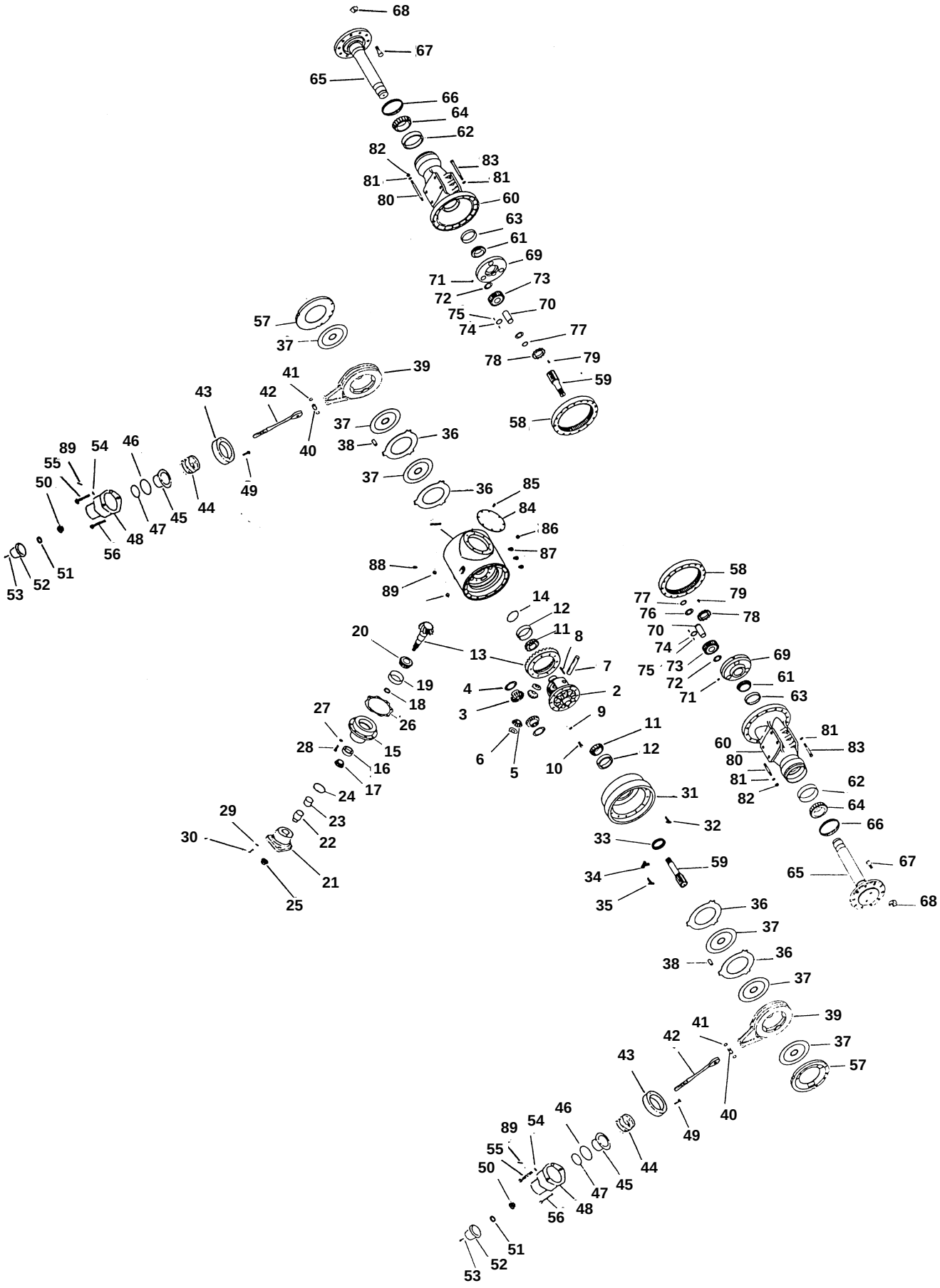


PRA 352 – Trumpet Variation No. 2

Item	Description
1	Center Housing
2	Differential Case Assembly
3	Side Gear
4	Side Gear Thrust Washer
5	Pinion Gear
6	Pinion Gear Thrust Washer
7	Spider Differential
8	Spiral Gear Capscrew Plain Washer
9	Spiral Gear Capscrew
10	Bearing Cone
11	Bearing Cup
12	Spiral Gear & Pinion Assembly
13	Differential Case Plain Washer
14	Differential Case Capscrew
15	Shim Differential Case
16	Pinion Cage
17	Bearing Cup
18	Bearing Cone
19	Pinion Bearing Spacer
20	Bearing Cup
21	Bearing Cone
22	Universal Joint Yoke
23	Oil Slinger
24	Oil Seal
25	Pinion Nut
26	Shim Pinion Cage
27	Pinion Cage Washer
28	Pinion Cage Capscrew
29	Brake Housing
30	Brake Piston
31	Oil Seal Piston
32	Oil Seal Piston
33	Piston Return Spring
34	Return Spring Bolt
35	Adjuster Ring
36	Adjuster Ring Lock
37	Adjuster Ring Lock Capscrew
38	Stationary Disc

Item	Description
39	Friction Disc
40	Brake Reaction Plate
41	Brake Disc Lock Pin
42	Ring Gear
43	Sun Gear, Short
43A	Sun Gear, Long
44	Adjusting Nut
45	Adjusting Nut Lock Capscrew
46	Planetary Pinion Flange
47	Shaft Planetary Pinion
48	Planetary Pinion Axle Capscrew
49	Planetary Pinion Thrust Washer
50	Planetary Pinion
51	Rollers
52	Spacer Rollers
53	Planetary Pinion Plain Washer
54	Snap Ring
55	Bearing Cone
56	Bearing Cup
57	Housing
58	Center Housing Stud
58A	Center Housing Stud
59	Washer
60	Center Housing Stud Nut
61	Center Housing Capscrew
61A	Center Housing Capscrew
62	Bearing Cup
63	Bearing Cone
64	Axle Shaft Oil Seal
65	Axle Shaft
66	Center Housing Cover
67	Center Housing Cover Capscrew
68	Drain Plug
69	Level Plug
70	Vent Plug
71	Hydraulic Bleeder
72	Capscrew
73	Wheel Bolt

PRA 353/383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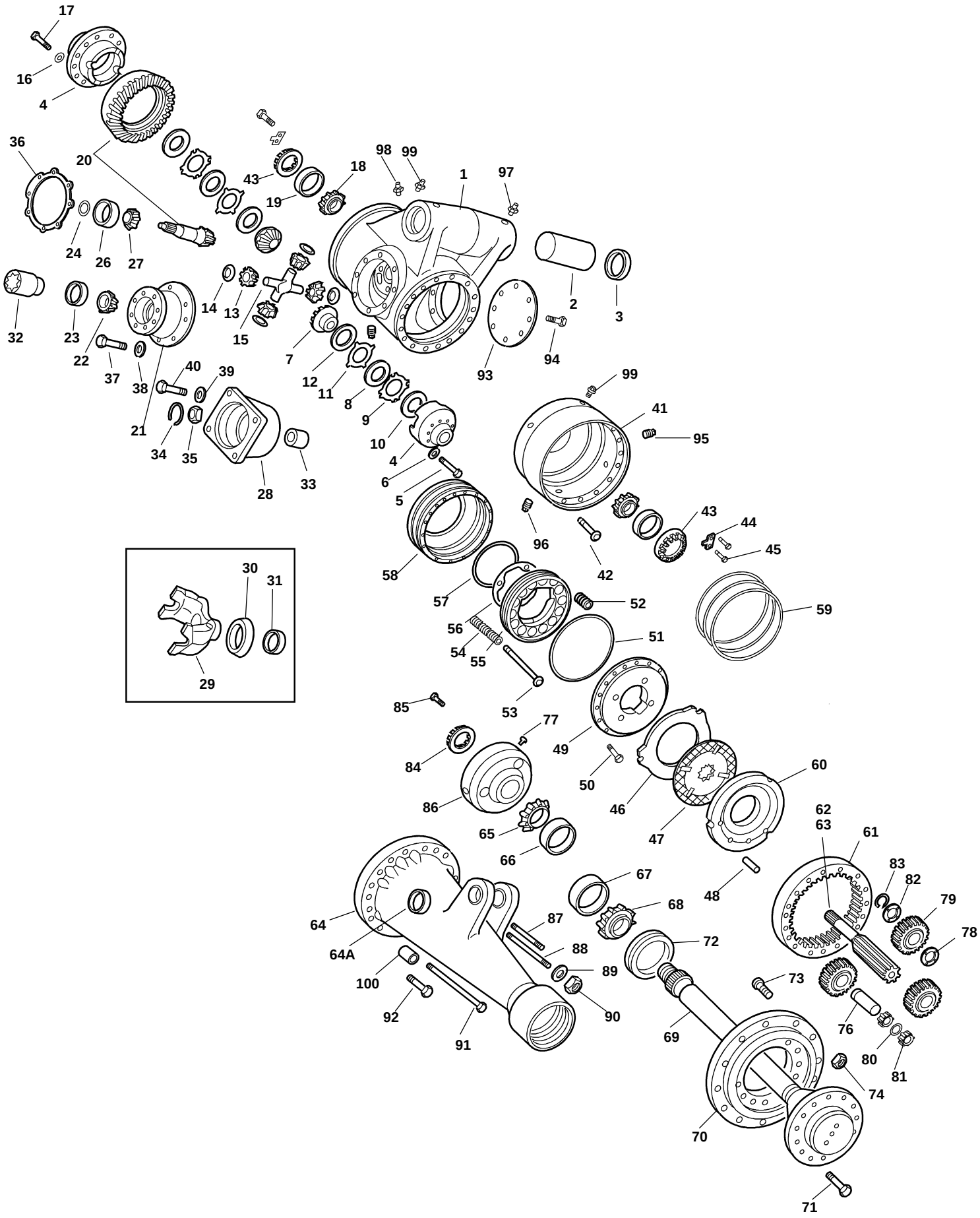
PRA 353/383

Item	Description
1	Center Housing
2	Differential Case
3	Side Gear
4	Thrust Washer
5	Pinion Gear
6	Thrust Washer
7	Differential Pinion Shaft
8	Pinion Shaft Lock Pin
9	Washer
10	Capscrew
11	Bearing Cone
12	Bearing Cup
13	Spiral Gear and Pinion
14	Differential Case Shim
15	Pinion Cage
16	Bearing Cup
17	Bearing Cone
18	Drive Pinion Shim
19	Bearing Cup
20	Bearing Cone
21	Motor Adapter Flange
22	Driven Sleeve
23	Drive Sleeve
24	Snap Ring
25	Pinion Nut
26	Pinion Cage Shim
27	Washer
28	Capscrew
29	Washer
30	Capscrew
31	Brake Housing
32	Capscrew
33	Adjuster Ring
34	Adjuster Ring Lock
35	Capscrew
36	Stationary Disc
37	Friction Disc
38	Brake Disc Lock Pin
39	Brake Assembly
40	Pin
41	Circlip
42	Brake Control Rod
43	Brake Cylinder Support
44	Spring
45	Brake Piston

Item	Description
46	O-ring
47	O-ring
48	Brake Cylinder
49	Capscrew
50	Adjusting Nut
51	Nut
52	Brake Cylinder Cover
53	Capscrew
54	Washer
55	Capscrew
56	Capscrew
57	Reaction Brake Plate
58	Ring Gear
59	Sun Gear
60	Housing
61	Bearing Cone
62	Bearing Cup
63	Bearing Cup
64	Bearing Cone
65	Axle Shaft
66	Axle Shaft Oil Seal
67	Wheel Bolt
68	Wheel Nut
69	Planetary Pinion Spider
70	Planetary Pinion Shaft
71	Capscrew
72	Thrust Washer
73	Planetary Pinion
74	Spacer
75	Kit Rollers
76	Washer
77	Snap Ring
78	Adjusting Nut
79	Adjusting Nut Lock Capscrew
80	Stud M14
81	Washer
82	Nut
83	Capscrew
84	Cover
85	Capscrew
86	Level Plug
87	Drain Plug
88	Vent Plug
89	Hydraulic Line Bleeder

PROA 352/382 (With Mechanical Drive Option)

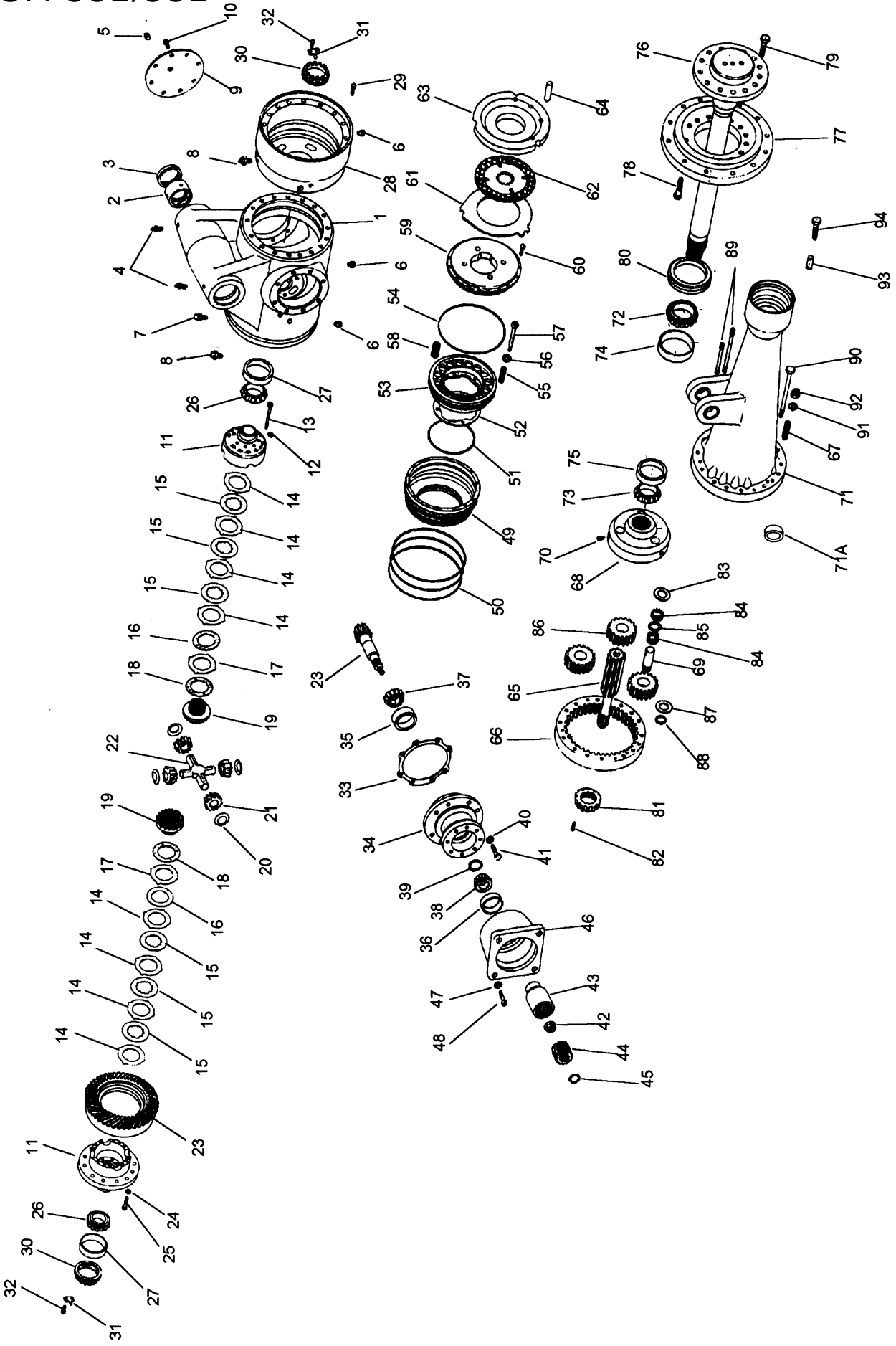


PROA 352/382 (With Mechanical Drive Option)

Item	Description
1	Main Housing
2	Bushing
3	Trunnion Oil Seal
4	Differential Case Assembly
5	Differential Case Capscrew
6	Differential Case Washer
7	Side Gear
8	Friction Discs Shim Pack
9	Friction Drive Disc
10	Friction Driven Discs
11	Compression Discs
12	Thrust Washer
13	Pinion Gear
14	Pinion Gear Thrust Washer
15	Spider
16	Gear Capscrew Washer
17	Gear Capscrew
18	Differential Case Cone Bearing
19	Differential Case Cup Bearing
20	Gear and Pinion Assembly
21	Pinion Bearing Case
22	Shaft Side Cone Bearing
23	Shaft Side Cup Bearing
24	Pinion Bearing Spacer
25	Not Shown
26	Head Side Cup Bearing
27	Head Side Cone Bearing
28	Adapter Flange
29	Universal Joint Yoke
30	Deflector
31	Pinion Oil Seal
32	Driven Sleeve
33	Drive Sleeve
34	Snap Ring
35	Pinion Nut
36	Pinion Bearing Cage Shim
37	Bearing Cage Capscrew Washer
38	Bearing Cage Capscrew
39	Flange Capscrew Washer
40	Flange Capscrew
41	Brake Housing
42	Brake Housing Capscrew
43	Adjusting Ring
44	Adjusting Ring Lock
45	Lock Capscrew
46	Stationary Disc
47	Friction Disc
48	Brake Disc Lock Pin
49	Action Plate
50	Bolt
51	Medium Oil Seal

Item	Description
52	Spring
53	Return Spring Capscrew
54	Return Spring
55	Inner Piston
56	Shim Pack
57	Small Oil Seal
58	Outer Piston
59	Oil Seal
60	Reaction Plate
61	Ring Gear
62	Short Sun Gear
63	Long Sun Gear
64	Axle Shaft Housing
64A	Bushing
65	Bearing Cone
66	Bearing Cup
67	Bearing Cup
68	Bearing Cone
69	Axle Shaft
70	Wheel Flange
71	Flange Capscrew
72	Axle Shaft Oil Seal
73	Wheel Capscrew
74	Wheel Nut
75	Not Shown
76	Planetary Gear Pin
77	Pin Capscrew
78	Flange Side Thrust Washer
79	Planetary Gear
80	Rollers Spacer
81	Rollers Kit
82	Thrust Washer
83	Snap Ring
84	Adjusting Nut
85	Adjusting Nut Lock Capscrew
86	Planetary Spider
87	Short Stud
88	Long Stud
89	Washer
90	Nut
91	Bolt
92	Brake Release Bolt
93	Main Housing Cap
94	Cap Capscrew
95	Level Plug
96	Drain Plug
97	Grease Plug
98	Vent Plug
99	Bleeder
100	Spacer

PROA 352/382



PROA 352/382

Item	Description
1	Center Housing
2	Bushing
3	Trunnion Oil Seal
4	Lubrication Fitting
5	Level Plug
6	Drain Plug
7	Vent Plug
8	Hydraulic Line Bleeder
9	Cover
10	Capscrew M8x1,25x16,0
11	Differential Case Assembly
12	Washer
13	Capscrew M10x1,5x80,0
14	Drive Disc
15	Driven Friction Disc
16	Clutch Disc Shim
17	Compression Disc
18	Thrust Washer
19	Side Gear
20	Thrust Washer
21	Pinion Gear
22	Spider
23	Spiral Gear & Pinion
24	Washer
25	Capscrew
26	Bearing Cone
27	Bearing Cup
28	Brake Housing
29	Capscrew
30	Adjuster Ring
31	Adjuster Ring Lock
32	Capscrew
33	Pinion Cage Shim
34	Pinion Cage
35	Bearing Cup
36	Bearing Cup
37	Bearing Cone
38	Bearing Cone
39	Drive Pinion Shim
40	Washer
41	Capscrew
42	Pinion Nut
43	Driven Sleeve
44	Drive Sleeve
45	Snap Ring
46	Motor Adapter Flange
47	Washer
48	Capscrew

Item	Description
49	Brake Piston Assembly
50	O-ring Piston
51	O-ring Piston
52	Piston Brake Shim
53	Brake Piston
54	O-ring Piston
55	Spring
56	Washer
57	Bolt–Return Spring
58	Spring
59	Brake Actuating Plate
60	Capscrew
61	Stationary Disc
62	Friction Disc
63	Brake Reaction Plate
64	Brake Disc Lock Pin
65	Sun Gear
66	Ring Gear
67	Capscrew
68	Planetary Pinion Spider
69	Planetary Pinion Shaft
70	Capscrew
71	Housing
71A	Bushing
72	Bearing Cone
73	Bearing Cone
74	Bearing Cup
75	Bearing Cup
76	Output Axle Shaft
77	Wheel Flange
78	Wheel Bolt
79	Capscrew
80	Axle Shaft Oil Seal
81	Adjusting Nut
82	Adjusting Nut Lock Capscrew
83	Thrust Washer
84	Kit Rollers
85	Spacer
86	Planetary Pinion
87	Washer
88	Snap Ring
89	Stud
90	Capscrew
91	Washer
92	Nut
93	Spacer
94	Brake Release Capscrew

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Description

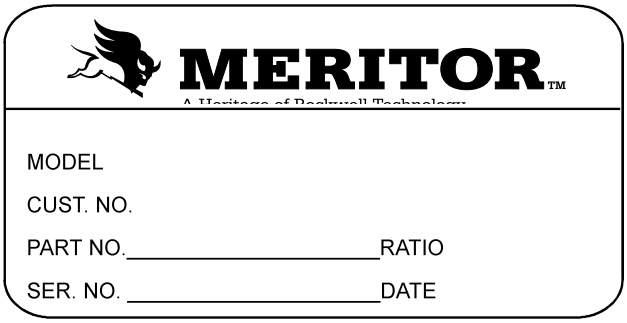
The Meritor PRA 352 Series Planetary Axle is a double reduction single speed unit that has:

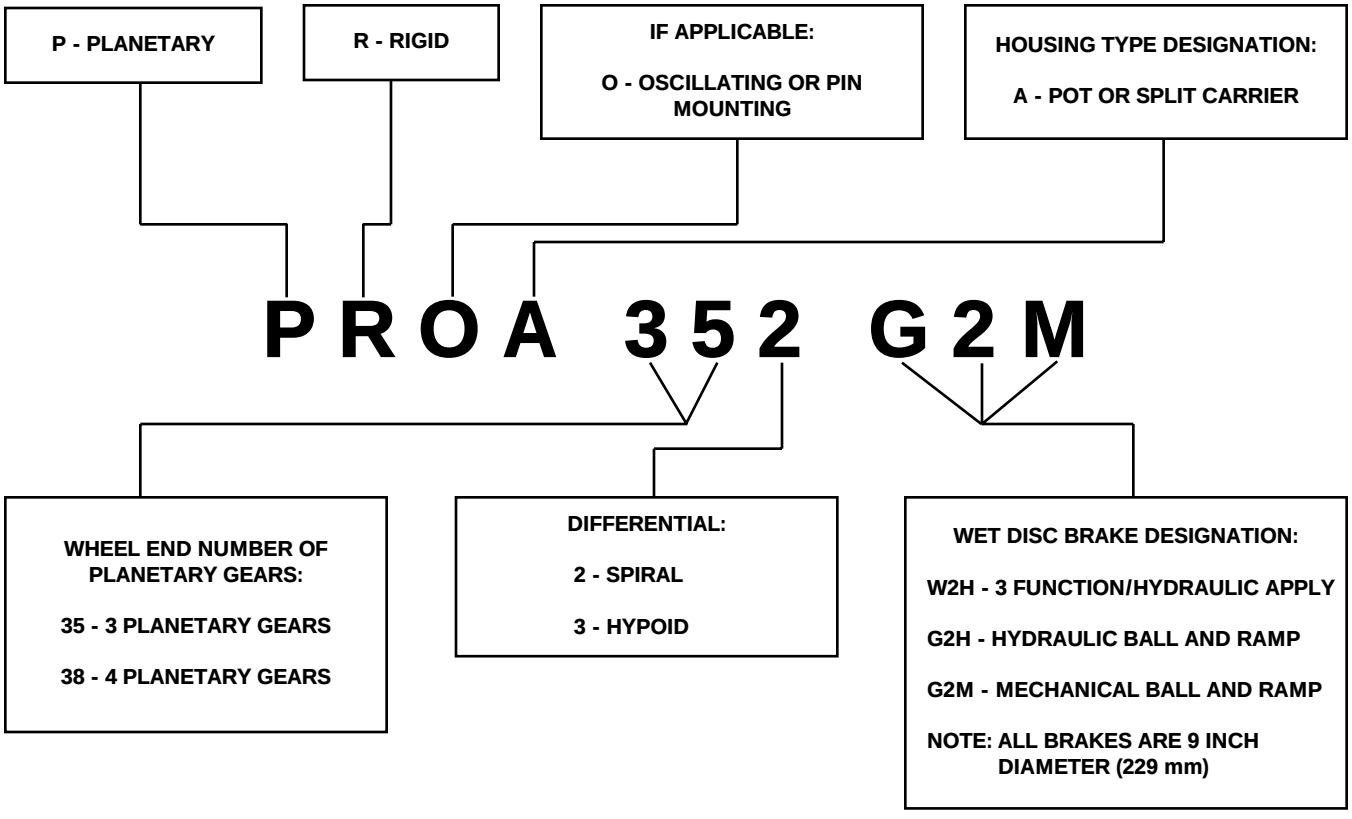
- A hypoid or spiral pinion and ring gear set
- Bevel gears in the differential assembly with 2 or 4 differential pinion gears
- A differential case assembly mounted on two tapered roller bearings
- A planetary system with 3 or 4 planetary pinion gears
- A trunnion mounting option
- An oil bath disc brake system in three different designs:
    1. Ball and Ramp
    2. Hydraulic Apply Wet Disc
    3. Three Function Brake

Identification

A tag on the main housing correctly identifies basic axle specifications.

When ordering parts, be sure to specify information stamped on the name plate. This information will allow easy identification of correct parts.





Remove Axle

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

WARNING

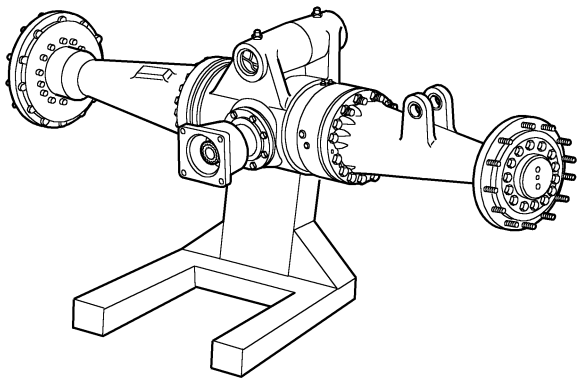
Support vehicle with safety stands. Do not work under a vehicle only supported by jacks. Jacks can slip or fall over and cause serious personal injury.

NOTE

While the housing configuration of the axle you service may differ from the figures shown, service instructions remain the same for all axle models addressed in this manual.

1. Make sure vehicle is on level surface.
2. Place blocks under wheels not being serviced to keep vehicle from moving.
3. Raise vehicle so that wheels to be serviced are off the ground. Support vehicle with safety stands.
4. Remove axle from vehicle.
5. Plug fluid lines that were connected to axle.
6. Place axle in appropriate repair stand. Center main housing on stand. **Figure 2.1.**
7. Remove drain plugs from brake housing and main housing with 12 mm Allen wrench. Drain axle oil.

Figure 2.1



The PROA 352 axle is shown to illustrate procedures in this maintenance manual

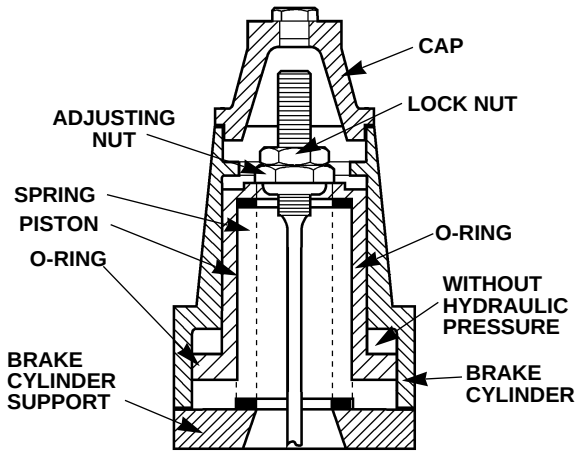
Disassemble Ball and Ramp Brake

NOTE

- ***Identify all parts before disassembly to ensure proper reassembly.***
- ***To disassemble hydraulic apply wet disc brake, go to page 5.***
- ***To disassemble three function brake, go to page 5.***

Figure 2.2.

Figure 2.2



1. Remove brake cylinder cover.
2. Remove nut and nut lock.
3. Loosen brake cylinder capscrews.
4. Remove brake cylinder assembly from main housing.

⚠ *CAUTION*

Loosen and remove brake cylinder capscrews alternately to avoid spring load damage to parts.

5. Disassemble brake cylinder assembly. Remove brake release capscrew. Loosen and remove brake cylinder capscrews alternately to avoid spring load to be supported by only one capscrew.
6. Remove spring, piston and O-ring seals. Do not cut or scratch them.
7. Clean cylinder and brake support surfaces. Do not damage ground surfaces.
8. Put parts of each brake cylinder assembly in separate plastic bags to avoid mixing them.

Disassemble Trumpet Assembly

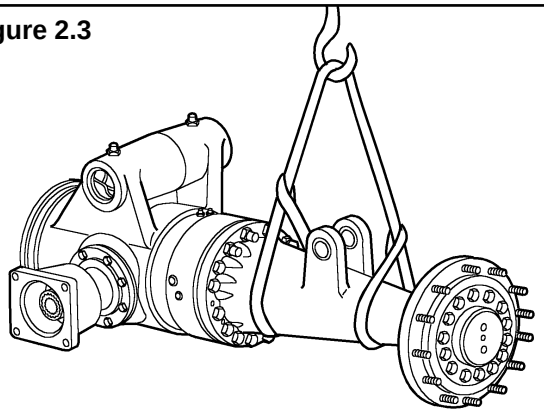
⚠ *WARNING*

To avoid serious personal injury and possible damage to components, be very careful when using lifting devices during removal and disassembly procedures.

- **Inspect to make sure that neither lifting strap is damaged.**
- **Do not subject lifting straps to any shock or drop loading.**

1. Support trumpet to be serviced with lifting device. **Figure 2.3.**
2. Loosen and remove trumpet nuts and bolts.

Figure 2.3



NOTE

For three function brake design: If bleeder and pressure ports of brake piston are open, the trumpet assemblies and ring gear will come off the center section easily without using puller holes. Cover pressure ports with rags to avoid contact with escaping oil.

3. Use two puller holes in trumpet flange to remove trumpet assembly from main housing.

NOTE

Use steps 1 through 3 to remove second trumpet assembly.

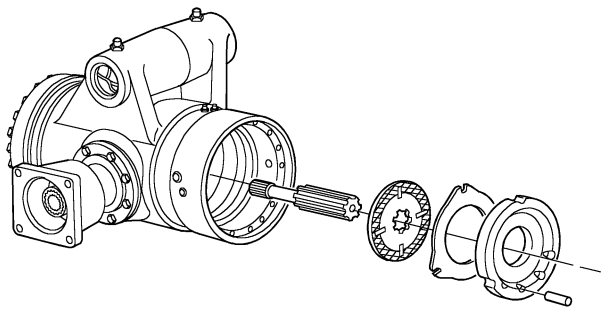
4. Remove ring gears from both sides through the two threaded puller holes. (Thread: M14 x 1.5 x 6 g).

⚠ *WARNING*

Do not hit steel parts with a steel hammer during removal and disassembly procedures. Parts can break and cause serious personal injury.

5. From main housing, remove sun axle shaft, spacers (if used), compression plates, stationary discs, friction discs, lock pins and expansive plate assemblies. To make lock pin removal easier, hit main housing with brass hammer. **Figure 2.4.**

Figure 2.4



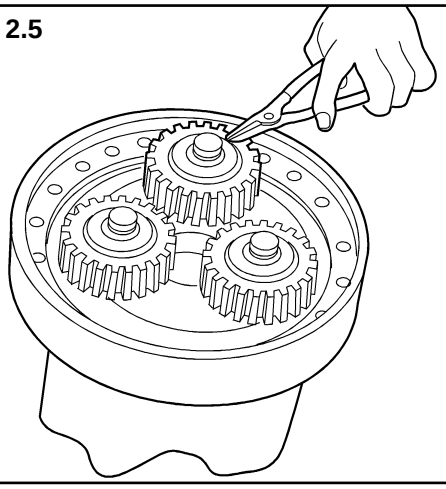
Disassemble Planetary System and Axle Shaft

NOTE

Before removing planetary gears, place housing in horizontal position or place cloth between pinion gear flange and housing flange to keep rollers from falling down into housing. To avoid mixing them, be sure to put rollers and spacers of each planetary gear in separate plastic bags.

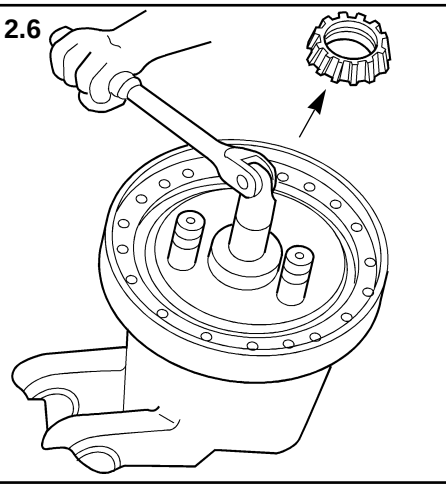
1. With pliers, remove snap rings. Disassemble planetary gears and rollers. **Figure 2.5.**

Figure 2.5



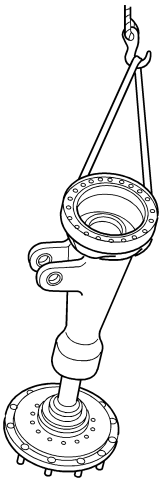
2. Remove axle shaft adjusting nut lock.
3. Remove axle shaft adjusting nut lock with special tool, illustrated in Section 6. **Figure 2.6.**

Figure 2.6



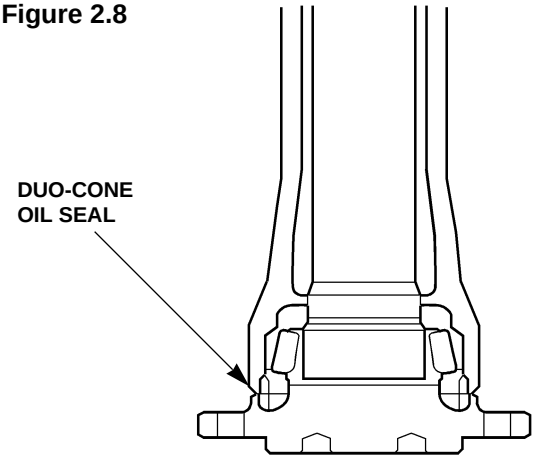
4. Remove pinion gear flange. Lift it through planetary gear pins.
5. Remove axle shaft assembly and cone bearing. If necessary, use press. **Figure 2.7.**

Figure 2.7



6. If necessary to change bearing cups, remove them with correct puller.
7. If necessary to replace DUO-CONE oil seal or axle shaft roller bearing cone, use correct puller. **Figure 2.8.**

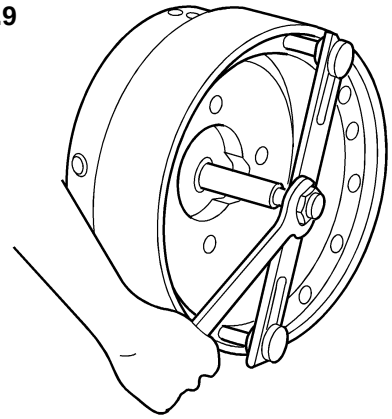
Figure 2.8



Disassemble Hydraulic Apply Wet Disc Brake

1. Remove piston return spring capscrews.
2. Remove return springs.
3. Remove brake piston assembly. **Figure 2.9.**

Figure 2.9

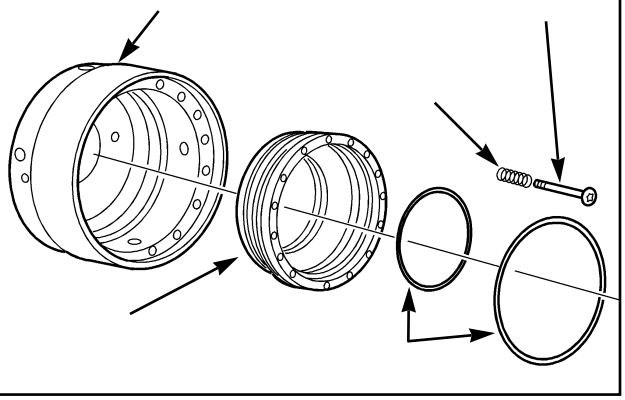


CAUTION

Ground oil seal surfaces must be properly protected to avoid damage. Whenever necessary, use No. 600 sandpaper to correct any damage.

4. If necessary, replace brake piston oil seals. **Figure 2.10.**

Figure 2.10



5. Follow steps 1 through 4 to disassemble the second brake piston.

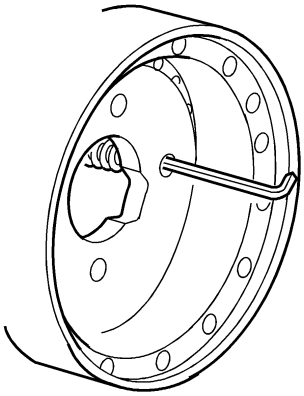
Disassemble Three Function Wet Disc Brake

NOTE

Do not disassemble brake piston unless necessary.

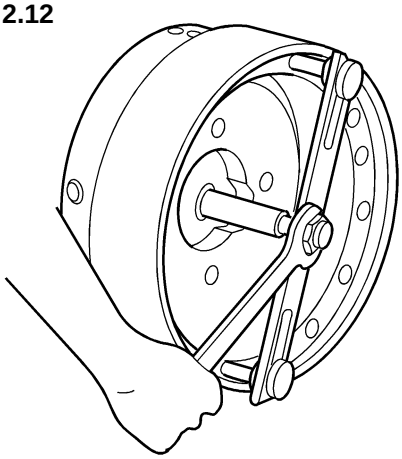
1. Remove return spring capscrews with 4 mm Allen wrench. Remove return springs and washers. **Figure 2.11.**

Figure 2.11



2. Remove brake piston assembly from brake housing as shown in **Figure 2.12** or place brake housing on a bench with the opening turned down. Inject 80 psi (5.5 bar) compressed air through inlet of service brake to eject brake piston.
3. Remove shims.

Figure 2.12



⚠ *WARNING*

- ***Use a special tool or press to compress the brake assembly to avoid serious personal injury from the spring pressure.***
- ***Observe all WARNINGS and CAUTIONS provided by the press manufacturer concerning press operation to avoid serious personal injury and damage to components.***

4. Compress brake piston assembly as shown in **Figure 2.13**; or place assembly in press and apply 1000 lbs. (450 kg) pressure.
5. Remove action plate capscrews. **Figures 2.13 and 2.14.**

Figure 2.13

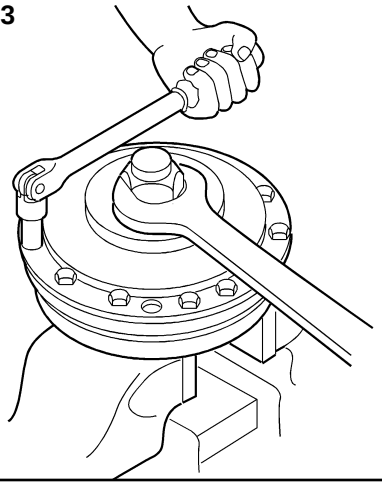
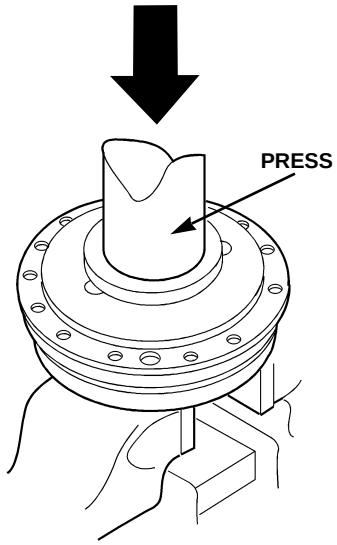


Figure 2.14

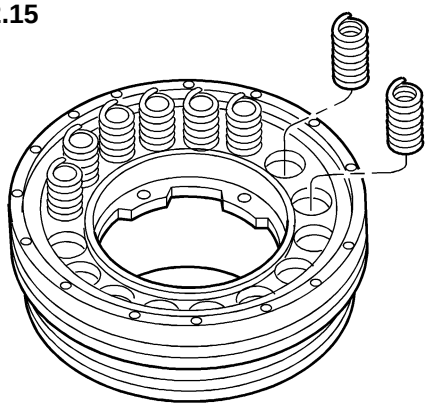


⚠ *CAUTION*

Before removing action plate and other parts, mark the original assembly positions of all brake piston assembly parts. This procedure will make reassembly easier.

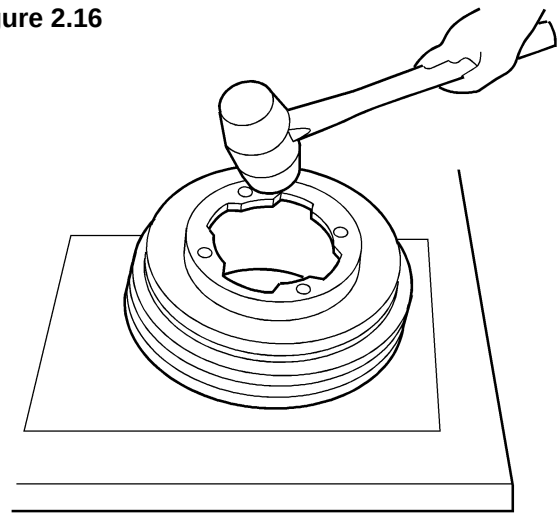
6. Remove action plate and springs. **Figure 2.15.**

Figure 2.15



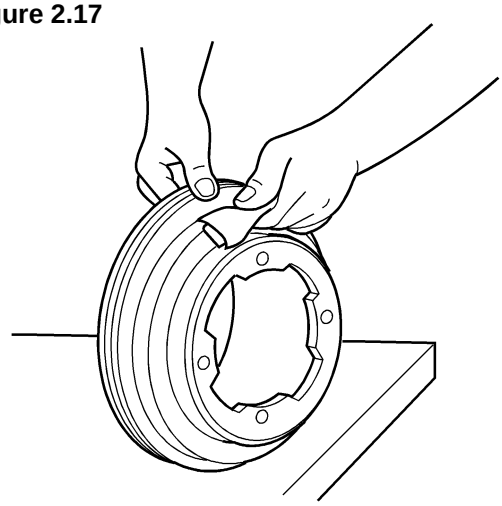
7. Remove internal piston by placing brake piston assembly on bench with action plate support surface turned down. Tap internal piston with rubber mallet. **Figure 2.16.**

Figure 2.16



8. Use sand paper on piston surfaces if they have nicks or hits. **Figure 2.17.**

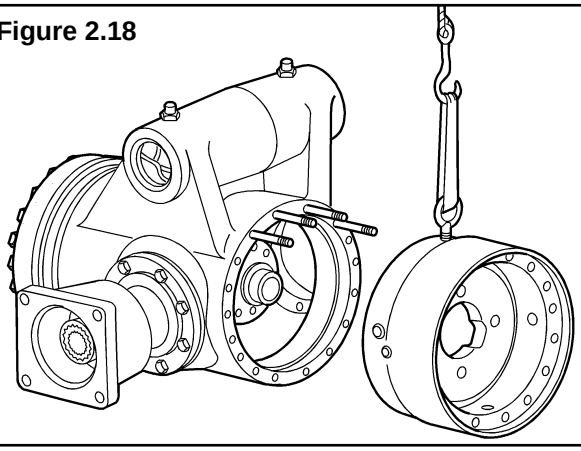
Figure 2.17



Disassemble Main Housing

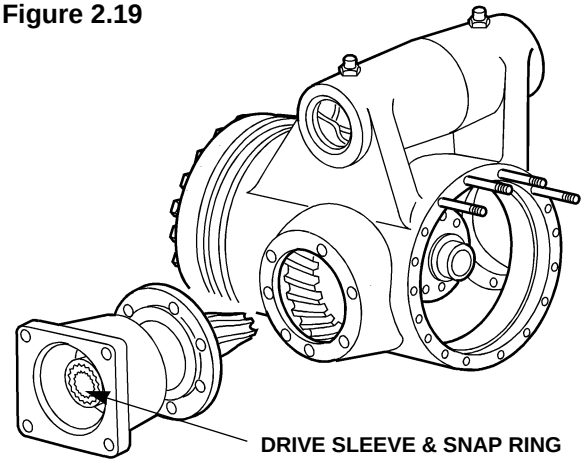
1. Remove adjusting nut capscrew lock.
2. Remove adjusting nut capscrew and adjusting nut.
3. Remove brake housing capscrews that are set deep in brake housing flange. Use long 6mm Allen wrench.
4. Remove brake housing from main housing. Hit brake housing with brass hammer or use two slots to remove it from main housing. Be careful not to hit ring gear. **Figure 2.18.**

Figure 2.18



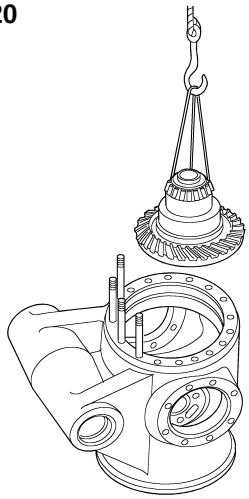
5. Depending on ring gear position, remove pinion bearing cage capscrews.
6. Remove pinion bearing cage assembly from main housing. **Figure 2.19.**
7. Remove drive sleeve and snap ring. **Figure 2.19.**

Figure 2.19



8. Remove differential case assembly. **Figure 2.20.**

Figure 2.20

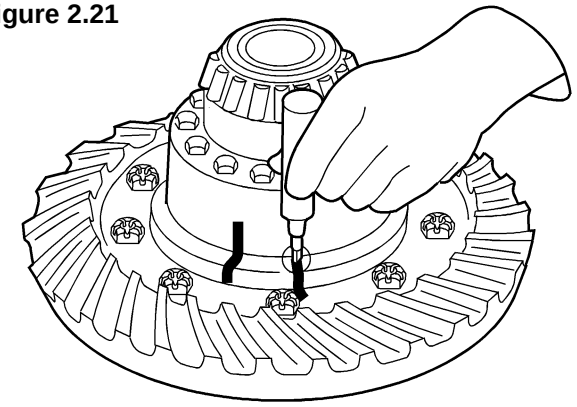


9. Remove main housing cover.

Disassemble Differential Case

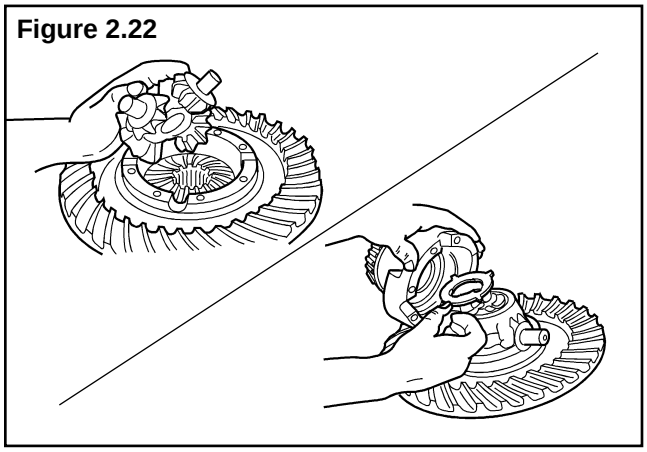
1. Before disassembling differential case, mark position of both halves and spider cross for easier reassembly. **Figure 2.21.**

Figure 2.21



2. Remove differential case capscrews.
3. Separate differential case halves. If necessary use a brass or rubber hammer to separate halves.
4. Remove spider cross, differential pinions, side gears and washers. If differential case is "Limited Slip," remove friction disc pack. **Figure 2.22.**

Figure 2.22



5. If differential case is "integral," remove differential pinion axle lock capscrew and differential pinion axle. Then turn side gears and remove differential pinions, side gears and washers. **Figures 2.23, 2.24 and 2.25.**

Figure 2.23

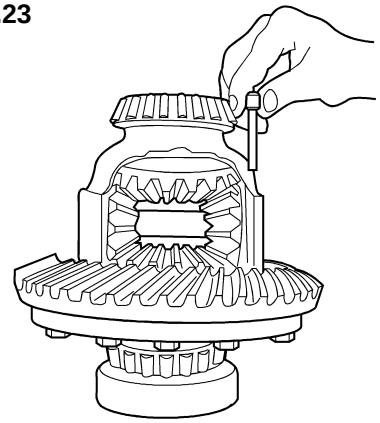


Figure 2.24

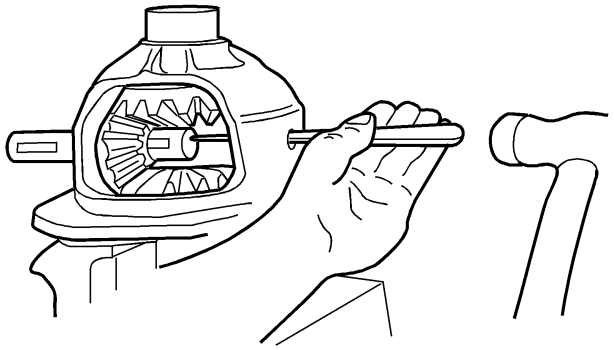
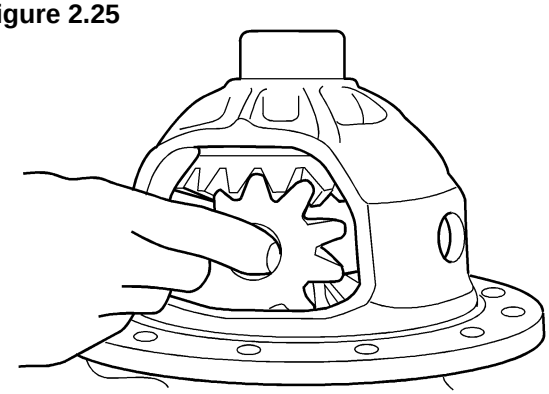


Figure 2.25



6. If necessary, separate ring gear from differential case. Remove capscrews and washers that fasten ring gear. With brass hammer, tap ring gear to separate it from differential case. **Figures 2.26 and 2.27.**

Figure 2.26

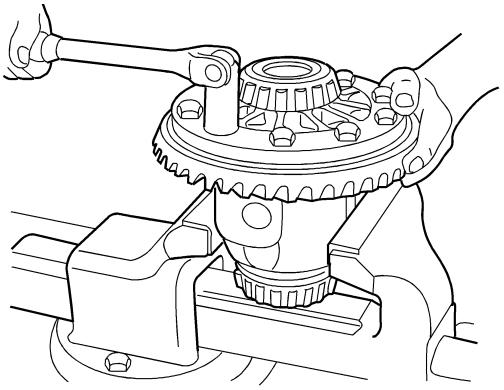
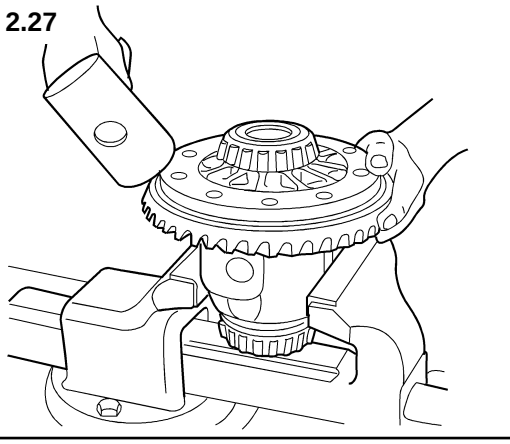


Figure 2.27

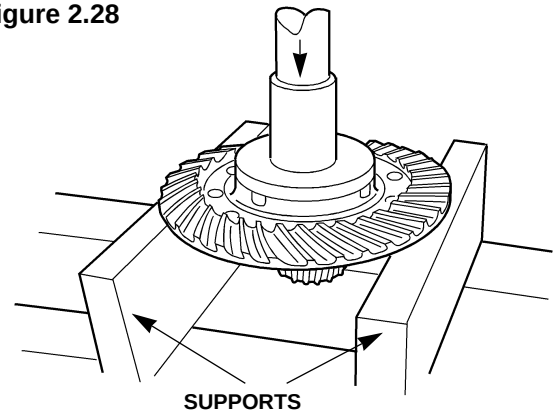


WARNING

Observe all WARNINGS and CAUTIONS provided by the press manufacturer concerning press operation to avoid serious personal injury and possible damage to components during removal and disassembly procedures.

7. If differential case has two halves, remove ring gear with a press after capscrews have been removed **(Figure 2.26)**. Use appropriate metal or wood supports. **Figure 2.28.**

Figure 2.28



8. If necessary, remove cone bearings from differential case. Use appropriate puller or press. **Figures 2.29, 2.30 and 2.31.**

Figure 2.29

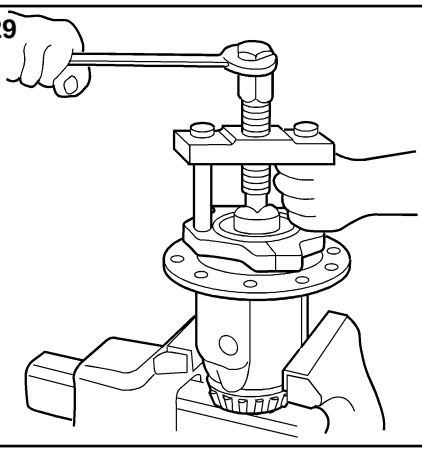


Figure 2.30

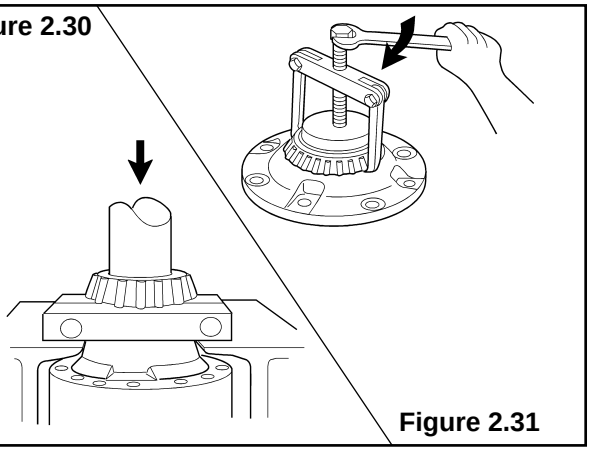


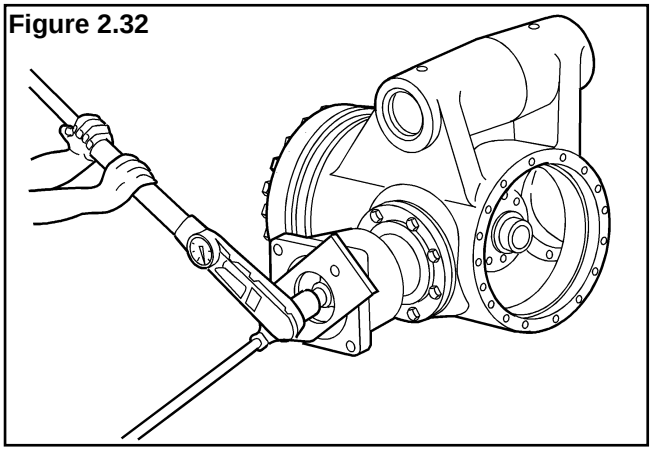
Figure 2.31

Disassemble Pinion Bearing Cage

1. If pinion bearing cage was not removed, hold yoke, flange or splined sleeve with appropriate holder to remove pinion nut. **Figure 2.32**

   If pinion bearing cage was already removed, place it on main housing and fasten with two capscrews.

Figure 2.32

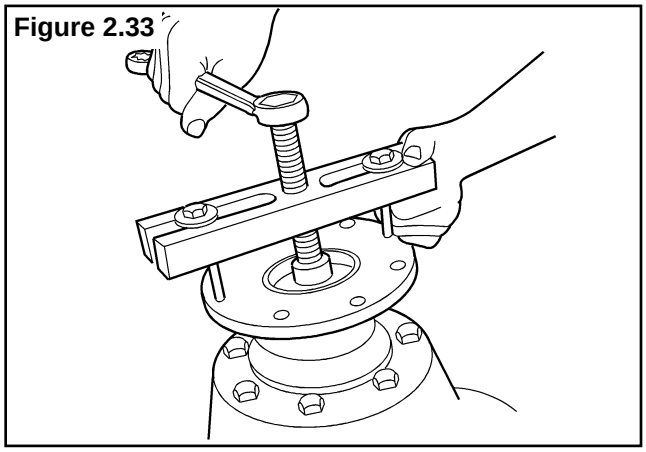


CAUTION

Do not use a hammer or mallet to loosen or remove yoke, flange or splined sleeve. The hammer or mallet can damage the parts or cause alignment problems. Do not damage the oil seal surface area.

2. Remove yoke, flange or splined sleeve from drive pinion with appropriate puller tool. **Figure 2.33.**

Figure 2.33

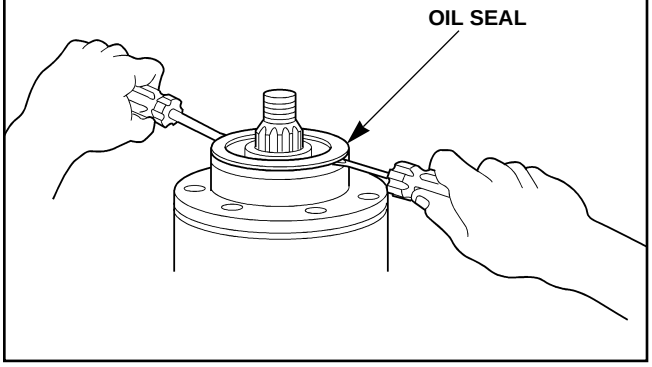


CAUTION

To avoid oil leaks, be careful not to damage the mounting surface of the bearing cage.

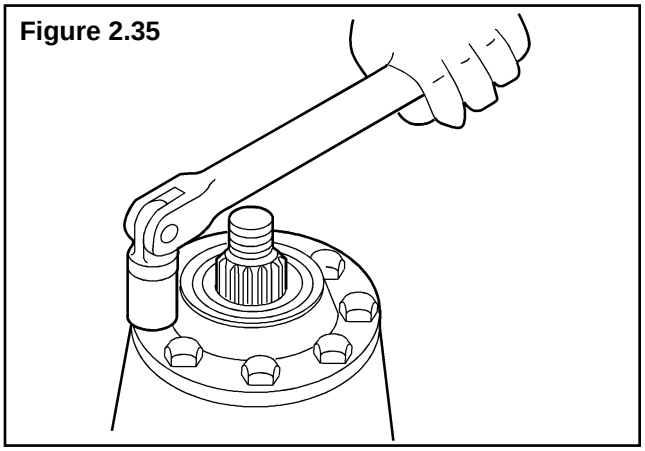
3. Remove pinion oil seal. Pry at several points around circumference between seal, flange and bearing cage. **Figure 2.34.**

Figure 2.34



4. Remove capscrews and washers that fasten pinion bearing cage on main housing. **Figure 2.35.**

Figure 2.35

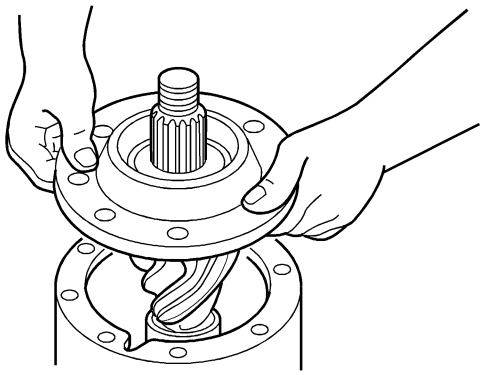


⚠ CAUTION

Do not use pry bar to remove bearing cage from carrier. A pry bar can damage bearing cage, shims and main housing.

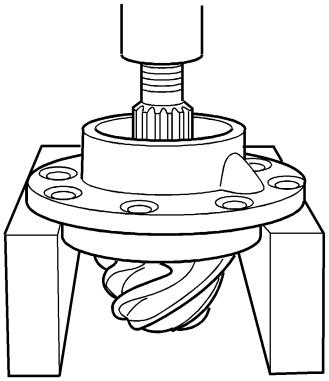
5. Remove pinion bearing cage and shims from main housing. If bearing cage is tight within the main housing, hit bearing cage at several points around flange area with leather, plastic or rubber mallet. **Figure 2.36.**

Figure 2.36



6. If shims are in good condition, keep them together for use later when main housing is reassembled.
7. Before damaged shims are discarded, measure and record total thickness of the pack. The dimension will be needed to calculate depth of drive pinion in main housing when gear set is installed.
8. Place drive pinion and bearing cage in press with pinion shaft toward top assembly. Support bearing cage under flange area with metal or wood blocks. Press drive pinion through bearing cage. **Figure 2.37.**

Figure 2.37



NOTE

The inner bearing cone and bearing spacer will remain on the pinion shaft.

9. If pinion bearing needs to be replaced, remove inner and outer bearing cups from inside of cage. Use a press and sleeve, bearing puller or small drift and hammer. **Figures 2.38 and 2.39.**

Figure 2.38

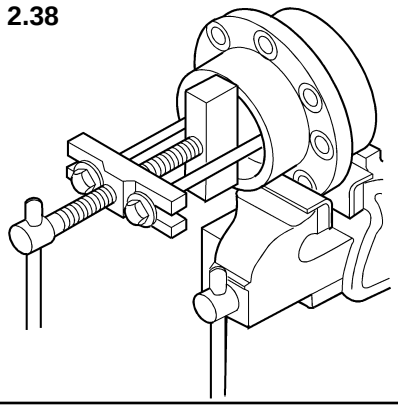
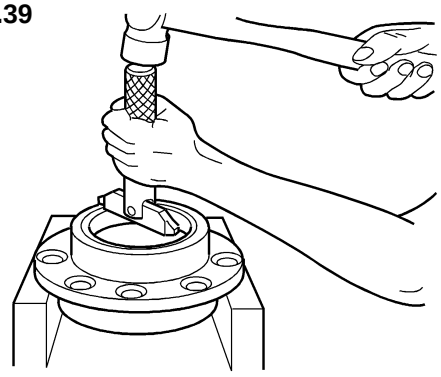
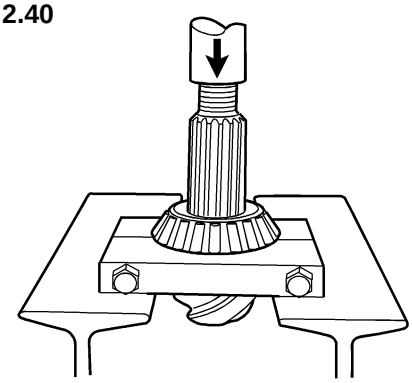


Figure 2.39



10. If pinion bearings need to be replaced, remove inner bearing cone from drive pinion with press or bearing puller. Puller must fit under inner face of cone to remove cone correctly without damage. **Figure 2.40.**

Figure 2.40



NOTE

If bearing cup is changed, the bearing cone must also be replaced. The cup and cone must come from the same manufacturer.

Clean Ground and Polished Parts

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

WARNING

If you use cleaning solvents, hot solution tanks or alkaline solutions incorrectly, serious personal injury can occur. To prevent serious personal injury, follow the instructions supplied by the manufacturer of these products. Do not use gasoline to clean parts. Gasoline can explode and cause serious personal injury.

- Use a cleaning solvent to clean ground or polished parts or surfaces. Kerosene or diesel fuel oil can be used for this purpose. NEVER USE GASOLINE.
- Remove gasket material from parts. Be careful not to damage ground surfaces.
- DO NOT clean ground or polished parts in a hot solution tank, water, steam or alkaline solution.

Clean Parts With Rough Finish

- Parts with a rough finish can be cleaned with cleaning solvent or in a hot solution tank with a weak alkaline solution.
- Parts must remain in hot solution tanks until completely cleaned and heated.
- Parts must be washed with water until the alkaline solution is removed.

Clean Axle Assemblies

- A complete axle assembly can be steam cleaned on the outside to remove dirt.
- Before the axle is steam cleaned, close or put a cover over all openings in the axle assembly. Examples of openings are breathers and hydraulic inlets.

Dry Cleaned Parts

- Dry the parts immediately after cleaning and washing.
- Dry the parts with soft clean paper or rags.

CAUTION

Damage to bearings can be caused if dried by rotating with compressed air.

- Except for bearings, parts can be dried with compressed air.

Prevent Corrosion

- Apply axle lubricant to cleaned and dried parts that are not damaged and are to be assembled.
- Apply a special material that prevents corrosion to all surfaces. If parts are to be stored, wrap the parts in special paper that prevents rust and corrosion.

Inspect Parts

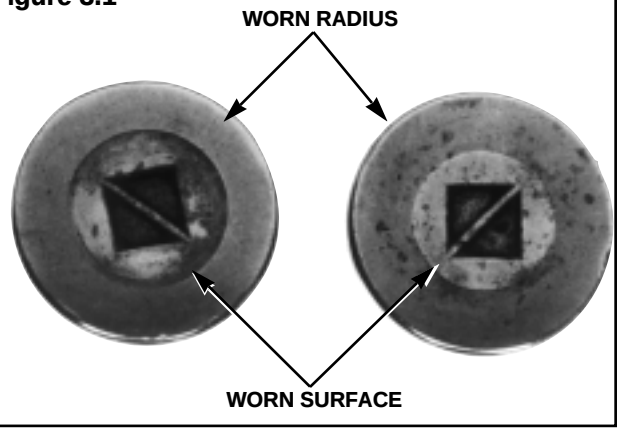
It is very important to inspect all parts carefully and completely before the axle or carrier is assembled. Check all parts for wear and replace damaged parts. Replacement of damaged or worn parts will prevent breakdown of assembly later.

Inspect Tapered Roller Bearings

Inspect the cup, cone, rollers and cage of all tapered roller bearings in the assembly. If any of the following conditions exist, the bearing must be replaced:

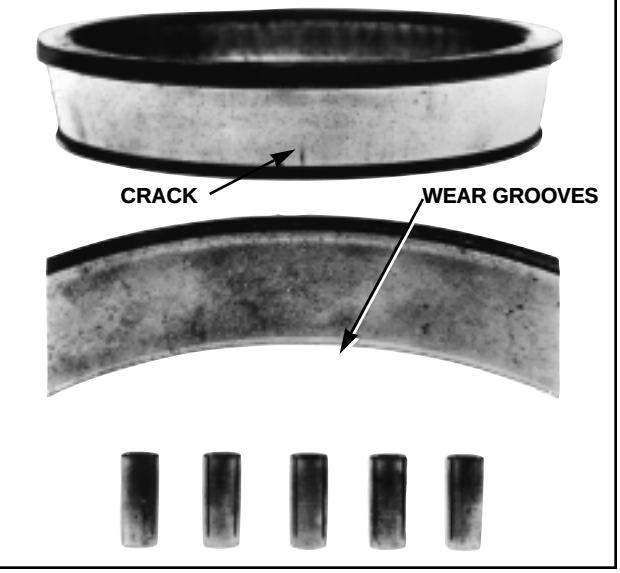
- The center of the large diameter end of the rollers are worn level with, or below the surface.
- The center of the large diameter end of the rollers are worn to a sharp edge. **Figure 3.1.**

Figure 3.1



- A visible roller groove in the cup or cone inner race surfaces. The groove can be seen at the small or large diameter end of both parts. **Figure 3.2.**

Figure 3.2

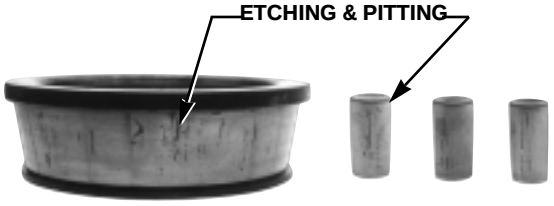


- Deep cracks or breaks in the cup, cone inner race or roller surfaces.
- Bright wear marks on the outer surface of the roller cage. **Figure 3.3.**

Figure 3.3

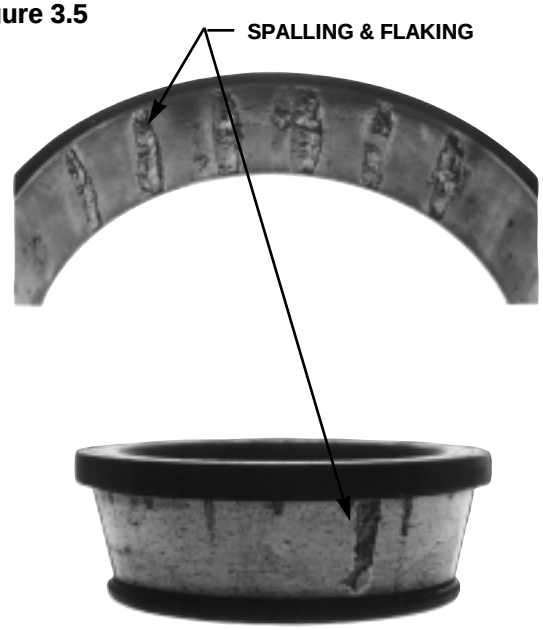
- Damage on rollers and on surfaces of the cup and cone inner race that touch the rollers. **Figure 3.4.**

Figure 3.4



- Damage on the cup and cone inner race surfaces that touch the rollers.**Figure 3.5.**

Figure 3.5



Inspect Hypoid Pinion and Ring Gear Sets

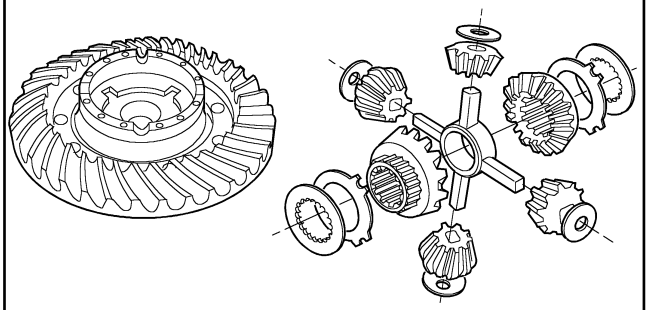
CAUTION

- ***Hypoid drive pinions and ring gears are machined in matched sets. When a drive pinion or ring gear of a hypoid set needs to be replaced, both drive gear and pinion must be replaced at the same time.***
- ***Inspect hypoid pinions and gears for wear and damage. Gears that are worn or damaged must be replaced. Also verify the cone bearing seats and spline in the pinion shaft.***

Inspect Main Differential Assembly

Parts that are damaged must be replaced. Inspect the following parts for wear or stress. **Figure 3.6.**

Figure 3.6



- Inside surfaces of both case halves
- Both surfaces of all thrust washers
- Four trunnion ends of spider cross
- Teeth and splines of both side gears
- Teeth and bore of all differential pinions
- Friction disc packs if used

CAUTION

Always replace old or worn thrust washers, differential side gears and pinion gears in sets to avoid higher stress and early damage to parts.

Inspect Axle Shafts

- For wear and cracks at flange, shaft and splines. Replace axle shaft if required.

Inspect Main Housing

- For fractures and burrs in machined areas.

Inspect Yoke

- For wear at seal journal area. Replace yoke, flange or sleeve if either shows too much wear at seal journal area.

Inspect Planetary System Parts

- For existence of cracks, pitting, breaks or sharp edges on planetary gear teeth, planetary gear axles and rollers.

Inspect Brakes

- For condition of friction discs, brake piston springs and internal brake housing surfaces.

Repair or Replace Parts

General Information

Replace worn or damaged parts of an axle assembly. The following are some examples to check for repair and possible replacement:

- Replace any fastener if corners of the head are worn.
- Replace washers if damaged.
- Replace gaskets, oil seals or grease seals at the time of axle repair.
- Clean parts and apply new liquid gasket material where required when axle is assembled.
- Remove nicks, marks and burrs from parts having machined or ground surfaces. Use a fine file, India stone, emery cloth or crocus cloth for this purpose.
- Clean and repair threads of fasteners and holes. Use a die or tap of the correct size or a fine file for this purpose.

CAUTION

Threads must be without damage and clean so that accurate adjustment and correct torque values can be applied to fasteners and parts.

- Tighten all fasteners to correct torque values. See chart in Section 6 for fastener torque values.

WARNING

Do not repair axle housings by bending or straightening. Repair of axle housings by bending or straightening can cause poor performance and possible unsafe operation of the axle. This can cause serious personal injury.

Repair Welding

In the interest of safety and preserving the service life of drive axle assemblies, Meritor recommends that assemblies are not repair welded. Repair welding can detract from the structural integrity of a component, particularly to heat treated parts where the benefit of heat treatment may be nullified by welding.

Since it can be extremely hazardous and detrimental to repair weld components of any kind, repair welding can be approved only where stringent controls are imposed and equipment, customarily located at manufacturing facilities, is employed, so as to minimize the potentially detrimental effects of repair welding.

Liquid Adhesive

Meritor uses the following liquid adhesives to retain threaded fasteners:

Product	Type	Color	Cure Time
Loctite	271 High	Red	2 hours
	241 Medium	Blue	6 hours
	221 Low	Violet	6 hours
Three Bond			
	1305 High	Red	5 hours
	1334 Medium	Green	5 hours
	1341 Low	Blue	10 hours

Disassemble Locked Sets

CAUTION

Do not use impact wrenches or strike components with a hammer.

To disassemble sets originally locked with liquid adhesive, use the regular mechanical disassembly procedure.

If the removal of a capscrew, for example, becomes difficult due to a worn head or unusually high breakaway torque, the locking strength can be reduced by heating the threaded area to approximately 300°F (150°C). Heat slowly to avoid thermal stresses on the differential case and gears.

Cleaning

WARNING

To avoid serious personal injury, trichloroethylene must not come in contact with your skin. Do not smoke and avoid breathing vapors in closed rooms without ventilation. Do not use trichloroethylene near flames, welding operations or hot surfaces exceeding 900°F (482°C).

Clean capscrew, nut or bolt tapped hole and fastener thread carefully. Use a cleaning solvent such as trichloroethylene or equivalent to remove dirt, oil, grease or moisture.

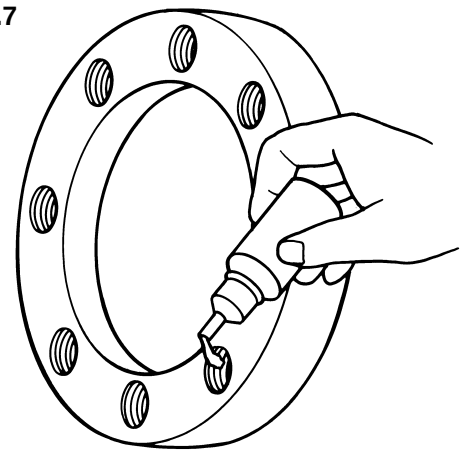
Reassembly

- Check the type of liquid adhesive to be used and where the adhesive is to be applied.
- In threaded holes where fasteners did not require removal, check each one for tightness by applying the minimum amount of specified torque.
- If fasteners do not rotate, they are tightened properly.
- If fasteners rotate to any degree, they must be removed and liquid adhesive must be applied.

Application

1. Apply liquid adhesive to:
   - Bolt threads when component has open hole. Before installing bolts, visually check to make sure that liquid adhesive has filled gap between threads.
   - Threaded hole when component has blind hole. Allow 4 to 6 drops to run down side of each hole. If liquid adhesive is applied to bolt, trapped air in hole will create back pressure and “blow out” liquid adhesive as bolt advances. **Figure 3.7.**

Figure 3.7



2. Tighten fasteners with recommended torque. (T)

Apply Silicone Gasket Material

Liquid gasket material used by Meritor:

- Loctite FAG 3
- Neutral Silicon, Dow Corning 768 or Rhodia 567/666
- Three Bond 1134
- Loctite 515

WARNING

Small amounts of acid vapor are present when applying some gasket materials. To prevent possible serious personal injury, make sure there is good ventilation in the work area. If liquid gasket material gets in your eyes, flush eyes with water for 15 minutes. Have eyes checked by doctor.

CAUTION

The amount of liquid gasket material applied must not exceed 0.125 in. (3.18 mm) diameter bead. Too much gasket material can block lubrication passages and result in damage to component.

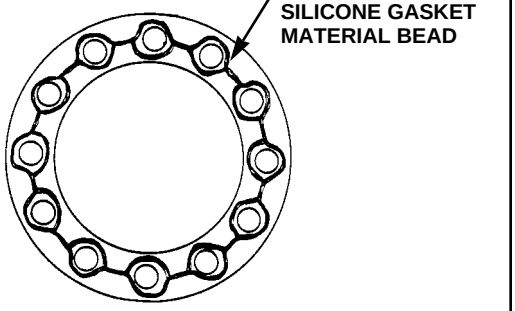
1. Remove all old gasket material from both surfaces.
2. Clean the surfaces where liquid gasket material will be applied. Remove all oil, grease, dirt and moisture.
3. Thoroughly dry both surfaces.
4. Apply according to the following procedures:

- **Three Bond 1134 or Loctite 515:** Apply approximately a 0.125 inch (3.18 mm) diameter continuous bead of liquid gasket material around one surface.
- **Loctite FAG 3:** Apply to one surface with a paint brush.

  Also apply all gasket material around edge of all fastener holes on that surface. **Figure 3.8.**

5. Assemble components quickly to permit gasket material to compress evenly between parts.

Figure 3.8



6. Tighten fasteners with required torque. See Torque Chart, Section 6. T

DUO-CONE Oil Seal: Mount and Install

NOTE

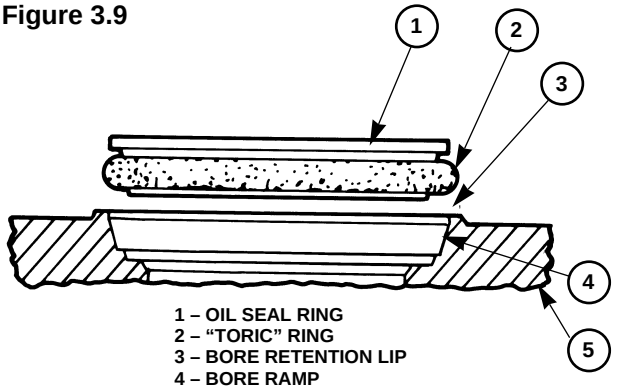
- ***Always follow correct procedures when mounting and installing DUO-CONE oil seals. Many DUO-CONE oil seal leaks result from errors made during mounting or installation of oil seal components.***
- ***Never let oil touch Toric ring or lodging ramps before both oil seal rings are installed in their mounting position.***

⚠ *WARNING*

To avoid serious personal injury, trichloroethylene must not come in contact with your skin. Do not smoke and avoid breathing vapors in closed rooms without ventilation. Do not use trichloroethylene near flames, welding operations or hot surfaces exceeding 900°F (482°C).

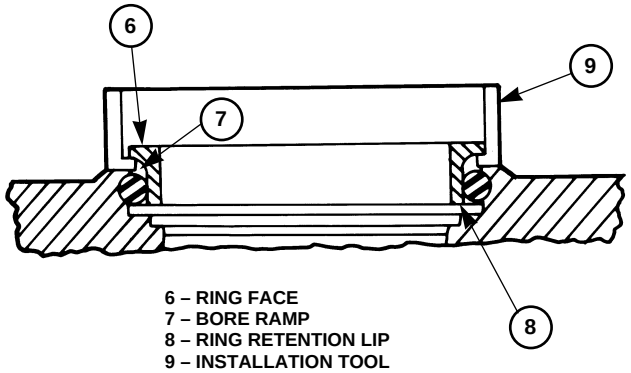
1. Remove any dust, oil or foreign material from Toric ring (2), lodging ramps (4, 7), ring retention lips (3, 8), oil seal ring (1) and ring bore (5). Clean components with trichloroethylene and a clean cotton cloth or a paper towel. **Figures 3.9 and 3.10.**

Figure 3.9



1 – OIL SEAL RING
2 – "TORIC" RING
3 – BORE RETENTION LIP
4 – BORE RAMP
5 – RING BORE

Figure 3.10

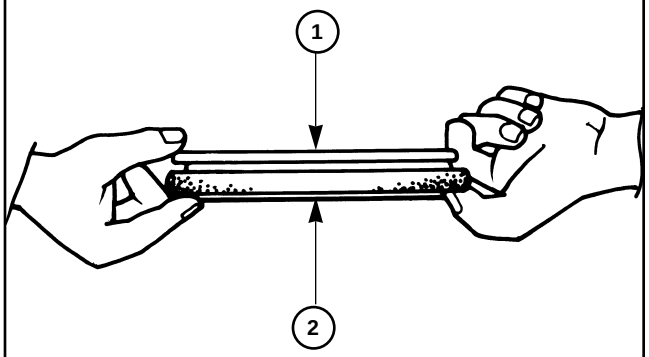


6 – RING FACE
7 – BORE RAMP
8 – RING RETENTION LIP
9 – INSTALLATION TOOL

⚠ *CAUTION*

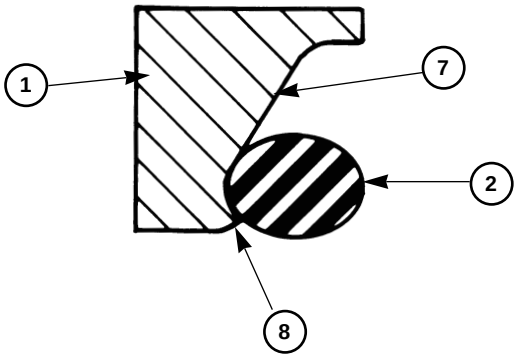
Make sure that Toric ring (2) is seated in oil seal ring (1). Be careful when you work with Toric ring. Cuts and scratches in Toric ring may cause leaks. **Figure 3.11.**

Figure 3.11



2. Place Toric ring (2) in oil seal ring (1) in button of ring ramps (7) and against ring retention lip (8). **Figure 3.12.**

Figure 3.12

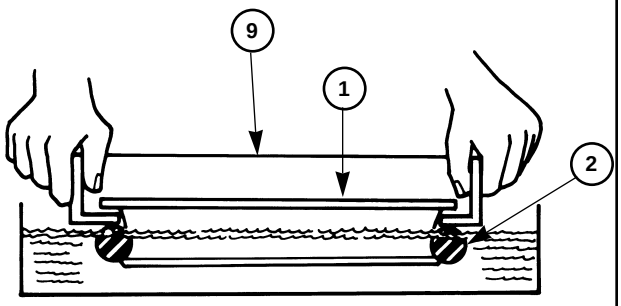


NOTE

Do not use any liquid that leaves a film of oil or does not evaporate quickly.

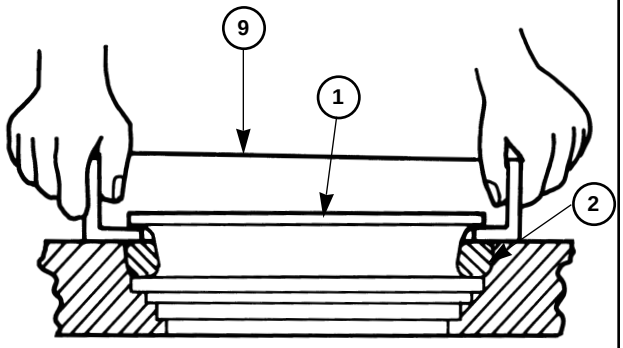
3. Place installation tool (9) under oil seal ring with Toric ring (2). Submerge ring in receptacle filled with trichloroethylene until entire surface of Toric ring is wet. **Figure 3.13.**

Figure 3.13



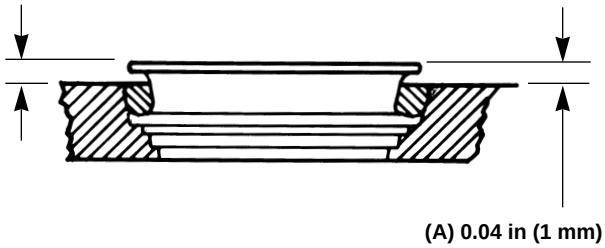
4. With Toric ring surface wet (2), use installation tool (9) to install oil seal ring and Toric ring perpendicular to ring bore. Use a rapid and uniform pressure to push Toric ring under ring retention lip. **Figure 3.14.**

Figure 3.14



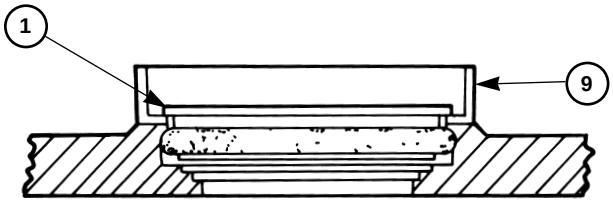
5. Verify mounting distance (A) in at least four places spaced 90 degrees apart. The difference in the mounting distance (A) around ring cannot be more than 0.04 inches (1 mm). **Figure 3.15.**

Figure 3.15



6. If adjustments are necessary, use installation tool (9) to push ring. Do not use your hands. **Figure 3.16.**

Figure 3.16

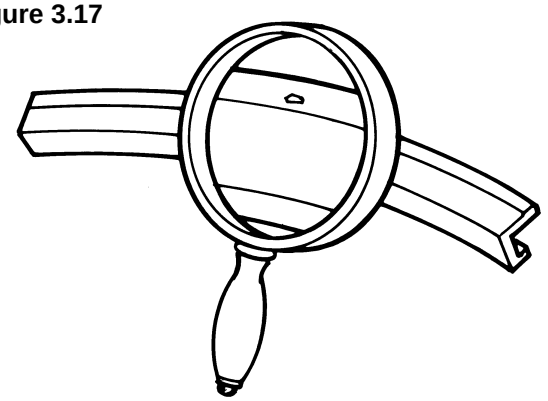


7. Toric ring may become distorted if not entirely wet or if there is a sharp edge on the retention lip and bore.

⚠ CAUTION

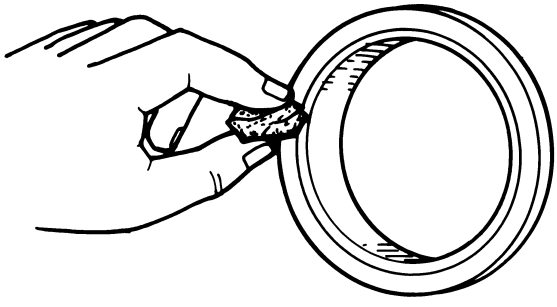
- ***Misalignment or a twisted Toric ring may cause leakage in the DUO-CONE oil seal. If installation was not correct, remove oil seal from bore and repeat steps 3-6.***
- ***A Toric ring must never slide on any ramp of oil seal ring or bore. To prevent sliding, wait at least two minutes for trichloroethylene to evaporate before continuing with installation. When in the correct position, Toric ring must roll only on ramps.***
- ***A small piece of lint can separate the oil seal surfaces and cause leaks.*** **Figure 3.17.**

Figure 3.17



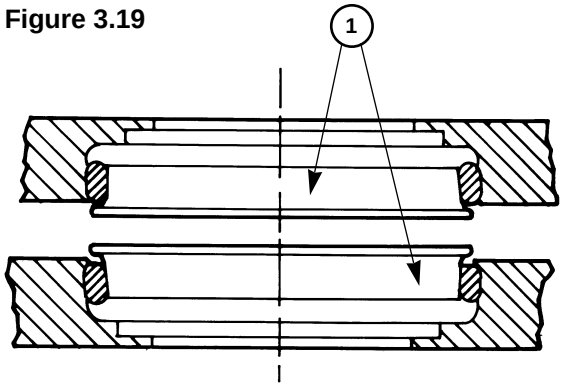
8. Clean oil seal surfaces with lint-free cloth or paper.
9. Apply a thin, uniform film of clean oil on oil seal surfaces with cloth or clean finger. Do not get oil on Toric ring. **Figure 3.18.**

Figure 3.18



10. Make sure both bores are correctly aligned and concentric. Move slowly and carefully. **Figure 3.19.**

Figure 3.19



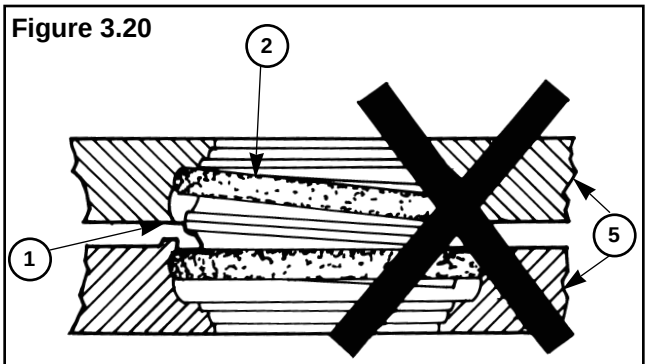
⚠ CAUTION

Do not force rings abruptly against each other. A strong impact may break the oil seal components. When seal is installed properly, fasten all components well.

If DUO-CONE oil seal is installed incorrectly, these conditions can result:

- Toric ring can warp. **Figure 3.20.**

Figure 3.20



- Warped ring can cause irregular pressure on ring surface resulting in oscillating movements of oil seal.
- Different pressures on oil seal surfaces can cause seepage, wear and leaks.
- Oscillating oil seals allow dirt to enter.

Figure 3.21 shows an incorrect installation of an oil seal in its mounting position. The upper bore is stopped and the lower lodge is rotating.

Figure 3.21

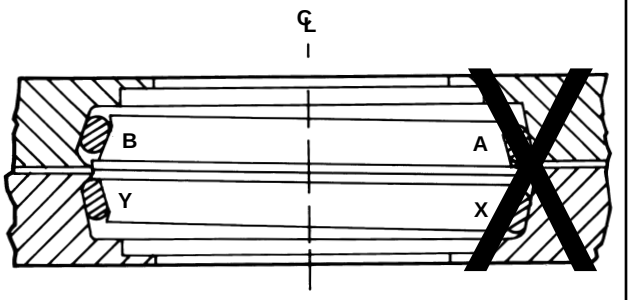
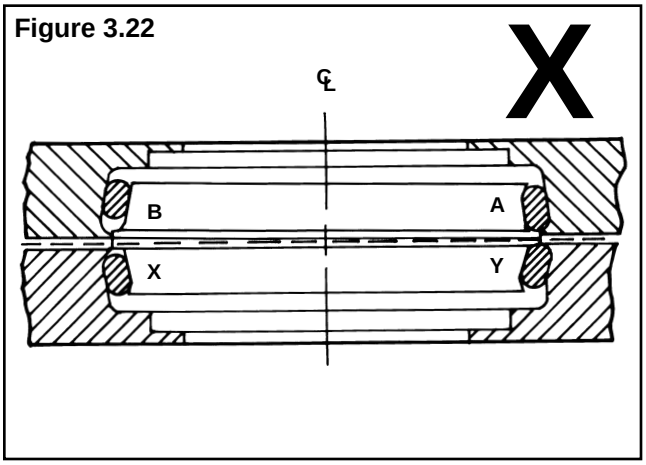


Figure 3.22 shows the same lower bore after rotation of 180 degrees. In this position, high pressure occurs on points “A” and “Y”. This high pressure variation may damage rings. Points “B” and “X” will develop low pressure and possible leakage.

Figure 3.22



Assemble Differential Case

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. Apply specified lubricant on all parts of differential case assembly before installation.

⚠ CAUTION

Never attempt to press a cold ring gear on the flanged half of the differential case. A cold ring gear will damage the case because of the tight fit. The tight fit can cause misalignment or excessive runout and will make final backlash and teeth contact adjustments very difficult.

⚠ WARNING

Wear safe clothing and gloves to protect yourself from serious personal injury when you touch the hot ring gear.

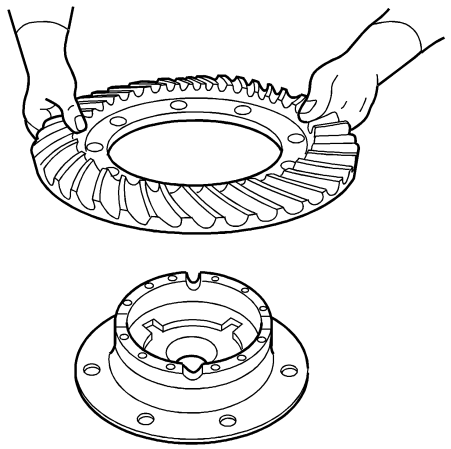
2. Expand ring gear bore by heating ring gear in tank of water heated 160°F to 180°F (71°C to 82°C) for 10 to 15 minutes. DO NOT USE AN OPEN FLAME SUCH AS A TORCH FOR THIS PROCEDURE.
3. Install ring gear on case half or in the integral differential case.

⚠ WARNING

To avoid serious personal injury be careful when using Loctite or Three Bond adhesive during assembly and installation procedures. Follow the manufacturer's instructions for safe use to prevent irritation to eyes and skin. Wash after skin contact. If the Loctite or Three Bond adhesive gets in the eyes, flush the eyes with water for 15 minutes. Have eyes checked by doctor.

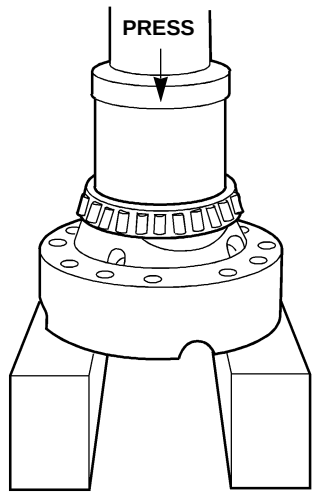
4. Apply Loctite 271 or Three Bond 1305 adhesive to ring gear fasteners. See Section 3, "Liquid Adhesive." Install ring gear fasteners and fasten with the specified torque, 66-75 lb-ft (90-100 N•m). **Figure 4.1.** T

Figure 4.1



5. Assemble new cone bearings in both halves of differential case or in both sides if it is an integral differential case. **Figure 4.2.**
6. Install side gear in flanged case half.

Figure 4.2

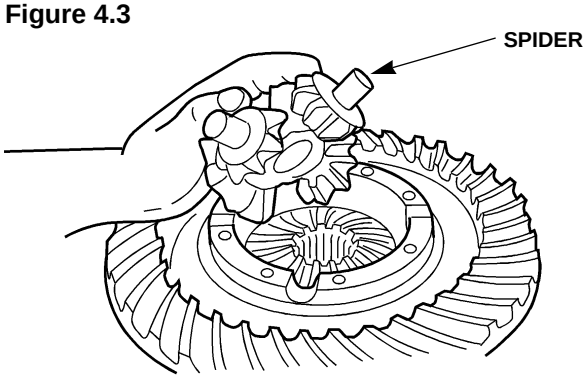


NOTE

For limited slip differential, go to step 12.

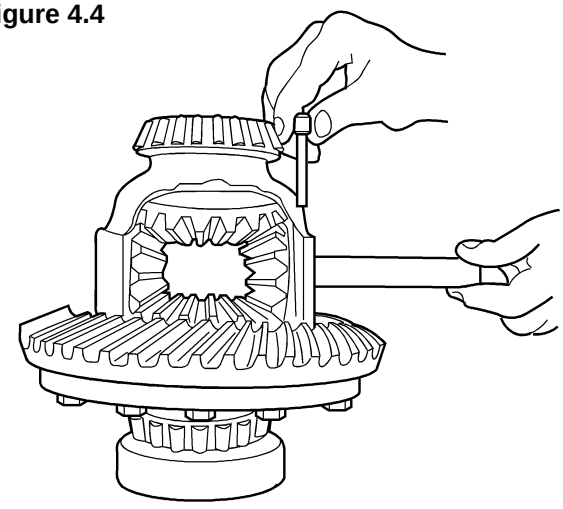
7. Install spider cross, differential pinions and washers on original assembly position. **Figure 4.3.**

Figure 4.3



   a. If you have an integral differential case, install side gears and washers in each original assembly side.
   b. Install differential pinions in the correct position by turning side gears until pinion holes are aligned with differential pinion axle holes. **Figure 4.4.**
   c. Install differential pinion washers.

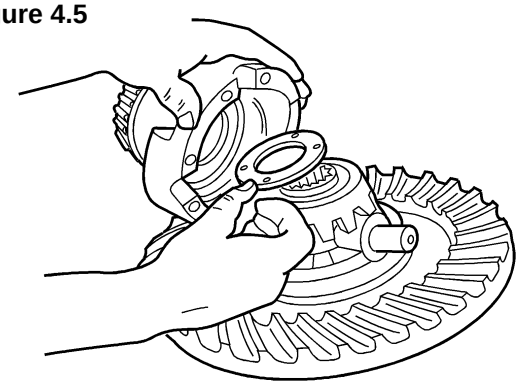
Figure 4.4



   d. Install differential pinion axle and lock capscrew. Fasten capscrew to specified torque 17-23 lb-ft (23-31 N•m).

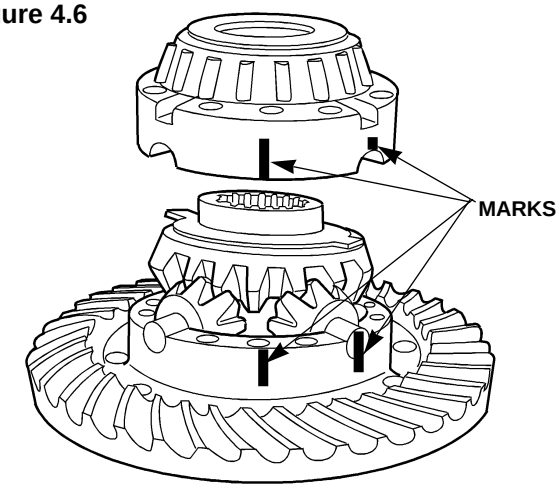
8. Install other side gear over spider and differential pinions. **Figure 4.5.**

Figure 4.5



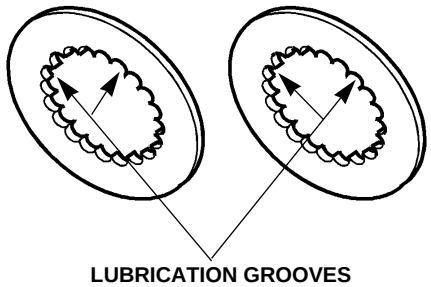
9. Place plain half of differential over flanged half. Rotate plain half as needed to align match marks. **Figure 4.6.**

Figure 4.6



10. Apply Loctite 271 or Three Bond 1305 liquid adhesive to capscrews. Install four capscrews into case halves equally spaced and tighten to 48-64 lb-ft (64-87 N•m). T
11. Install other capscrews into case halves. Tighten the capscrews to 48-64 lb-ft (64-87 N•m). T
12. Assemble Limited Slip Differential Case.
    a. Follow steps 1 to 5.
    b. Place flanged case half on bench.
    c. Begin stacking of the disc pack with a drive disc followed by driven friction discs. Make sure lubrication grooves are aligned. **Figure 4.7.**

Figure 4.7



Maintain the following sequence:

1) Drive disc
2) Driven friction disc
3) Drive disc
4) Driven friction disc
5) Drive disc
6) Driven friction disc
7) Drive disc
8) Shims (Do not stack until measurements are complete.)
9) Compression disc
10) Thrust washer (on side gear side)

    d. Place disc pack stack in vise. Use micrometer to determine “D”, the height (thickness) of limited slip disc stack (includes thrust washer and compression disc). Take four readings, one at each of four points. Average readings to determine “D”. **Figures 4.8 and 4.9.**

Figure 4.8

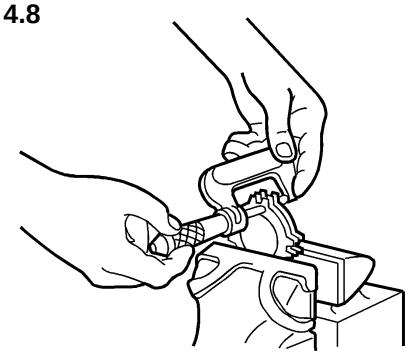
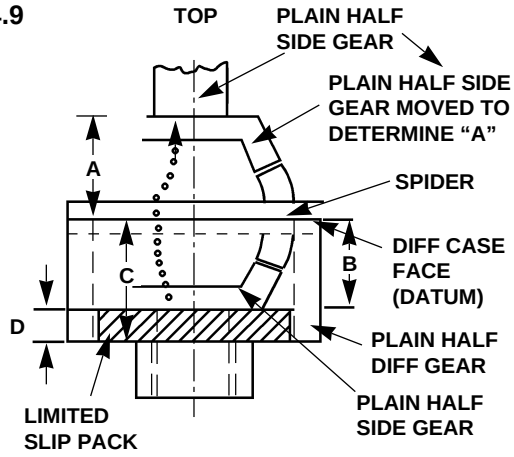


Figure 4.9



A: Differential case half flange to back of differential side gear distance.

B: Differential case face to side gear seat.

C: Differential case half depth.

D: Stack height (thickness).

    e. Use depth gauge to determine “C”, depth of differential case half. Take four readings. Average readings for result. **Figure 4.9.**

f. Place removed plain half side gear on top as shown in **Figure 4.10.** Use depth gauge to determine “A”, distance from differential case half flange to backside of differential side gear. Take four readings. Average readings for result. **Figure 4.10.**

g. Determine clearance dimension: B-A=(C-D)-A. Clearance dimension must be greater than 0.05 mm and less than 0.15 mm.

h. Use proper shim thickness to achieve clearance specified in step G.

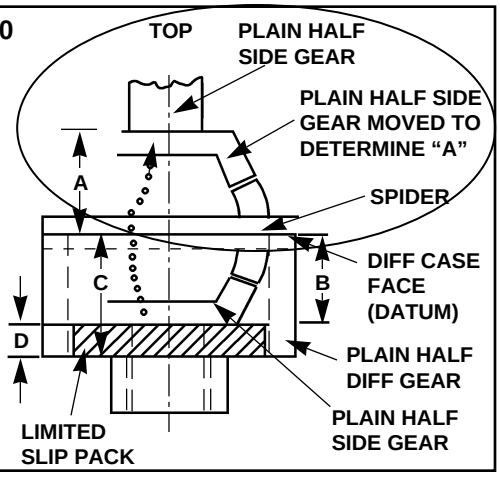
i. Assemble friction discs in differential case using sequence in step C including shims. Make sure discs are lubricated.

j. Drop side gear spline through disc pack.

k. Repeat steps “A” through “I” for the plain differential case half.

l. Follow steps 9 through 11 to assemble differential case.

Figure 4.10

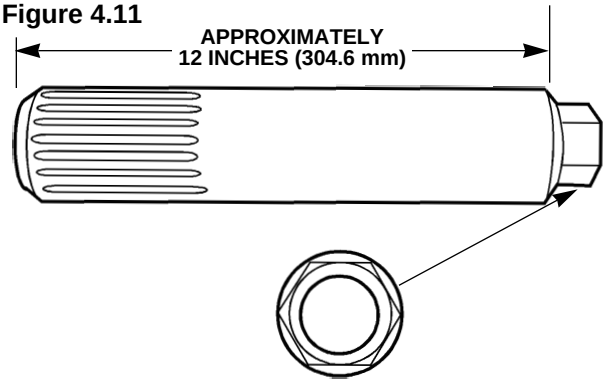


Check Rotating Resistance of Differential Gears (Not Limited Slip)

NOTE

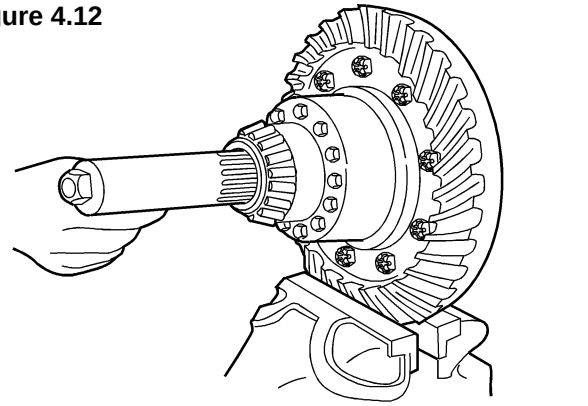
Make tool to check rotating resistance of the differential gears, 50 lb-ft (68 N•m). The tool can be made from a sun gear that matches the spline of the differential side gear. **Figure 4.11.**

Figure 4.11



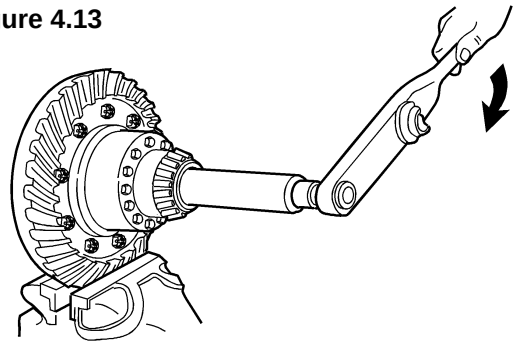
1. Place differential case assembly in a vise with soft metal covers on the vise jaws. Install the tool into differential until splines of tool and one side gear are engaged. **Figure 4.12.**

Figure 4.12



2. Attach torque wrench to the tool nut and rotate differential gears. As differential rotates, read torque value indicated on dial. **Figure 4.13.** T

Figure 4.13



3. If torque value exceeds specification of 50 lb-ft (68 N•m), disassemble gears from differential case. T
4. Check differential case halves, spider, gears and thrust washers for problem that causes excessive torque value. Repair or replace parts.
5. After parts are repaired or replaced, assemble parts and repeat steps 1 to 4.

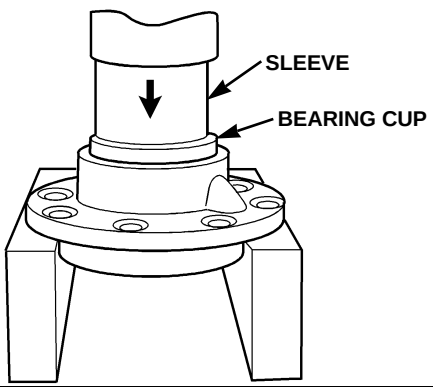
Assemble Drive Pinion and Bearing Cage

⚠ *WARNING*

Observe all WARNINGS and CAUTIONS provided by the press manufacturer concerning press operation to avoid serious personal injury and possible damage to components during assembly and installation procedures.

1. Place bearing cage in press. **Figure 4.14.**

Figure 4.14.



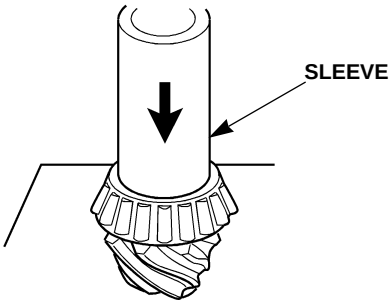
2. Support bearing cage with metal or wood blocks.
3. Press the bearing cup into bore of bearing cage until cup is flat against bottom of bore. Use correct size sleeve to install bearing cup.

NOTE

Use same procedure for both bearing cups.

4. Put drive pinion in press. The gear head (teeth) must face toward the bottom.
5. Press inner bearing cone on shaft of drive pinion until cone is flat against gear head. Use a sleeve of the correct size against bearing inner race. **Figure 4.15.**

Figure 4.15

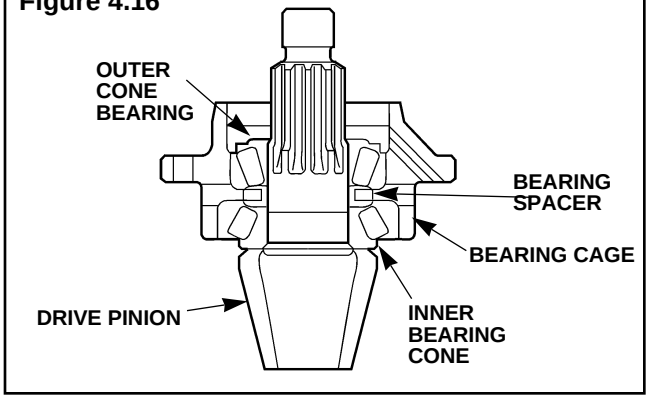


6. Apply axle lubricant on bearing cups in cage and bearing cones.
7. Install drive pinion into bearing cage.
8. Install bearing spacer(s) in pinion shaft against inner bearing cone. **Figure 4.16.**

NOTE

Spacer(s) controls preload adjustment of drive pinion bearings.

Figure 4.16



9. Install outer bearing cone on pinion shaft against spacer. **Figure 4.16.**

NOTE

Do not install pinion oil seal in bearing cage before bearing preload adjustment. Continue adjusting preload of pinion bearings.

10. Press outer cone bearing with 10 ton force and check preload of bearings. **Figure 4.16.**

Adjust Pinion Bearing Preload (Without Press)

NOTE

- ***If the preload value is below the specified range, install a thinner bearing spacer.***
- ***If the preload value is over the specified range, install a thicker bearing spacer.***

Calculation Example:

Data:
Radius: 9.3 cm (3.65 in)
Load: 2.3 Kg (5.0 lbs)

Calculation Procedure:
2.3 Kg x 9.3 cm = 21.4 Kg-cm
5.0 lb x 3.65 in = 18.25 lb-in.

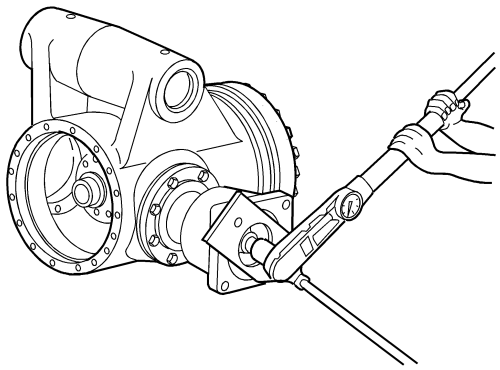
Conversion to N•m:
21.4 x 0.098 = 2.1 N•m
18.25 x 0.113 = 2.1 N•m

NOTE

- ***To convert lb-in to N•m: multiply by 0.113***
- ***Kg-cm to N•m: multiply by 0.098***

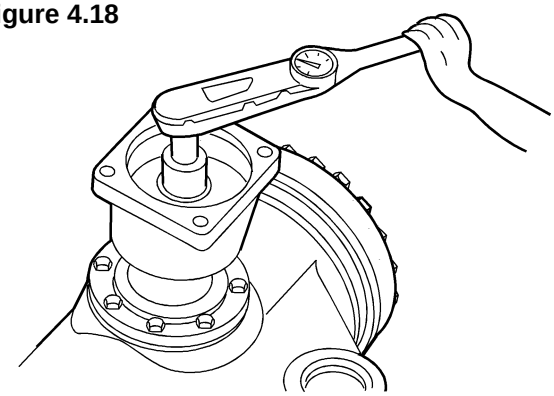
1. Lubricate bearing cups and cones with specified oil.
2. Install yoke or flange without pinion oil seal.
3. Install pinion bearing cage assembly on main housing without bearing cage shims.
4. Fasten bearing cage assembly on main housing with two capscrews. Apply minimum specified torque of 67 lb-ft (90 N•m). T
5. Use appropriate tool to fasten pinion through yoke, flange or splined sleeve. **Figure 4.17.**

Figure 4.17



6. Tighten pinion nut with minimum torque value of 465 lb-ft (630 N•m). T
7. Rotate pinion bearing cage several times so bearings make normal contact.
8. Attach torque wrench on drive pinion nut. Rotate pinion and check if preload is in specified range. Make the reading during the rotation, not the starting value. **Figure 4.18.**

Figure 4.18



9. If the pinion bearing preload torque value is under or above the specified preload torque of 5-20 lb-in (0.55-2.2 N•m), change shims to thick or thinner size as necessary. Repeat pinion bearing preload check. T

10. After getting specified preload, remove bearing cage from main housing and disassemble yoke or input flange.

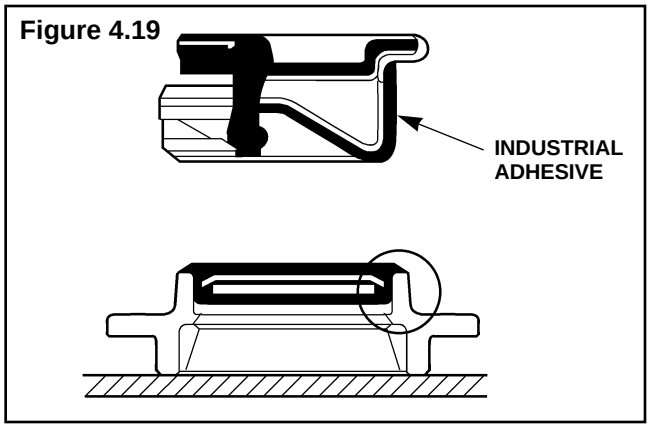
⚠ CAUTION

Make sure oil seal lips are clean and free from dirt. Dirt can cause leakage between seal and yoke or flange.

11. Install pinion oil seal with the appropriate tool:

    a. Apply extreme pressure lithium soap grease to oil seal lips. **Figure 4.19.**

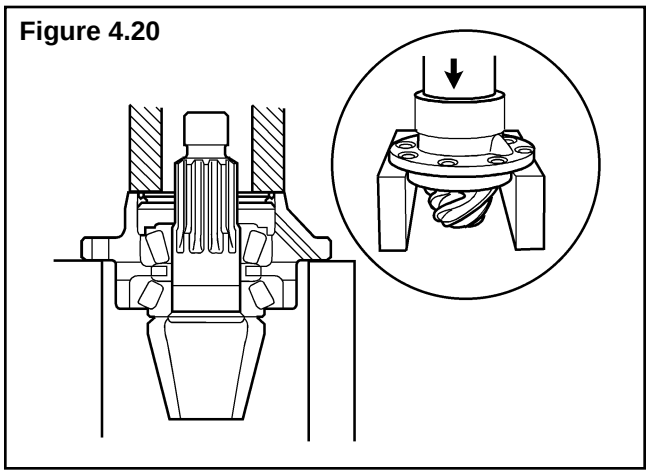
Figure 4.19



    b. Apply 3M Industrial Adhesive or equivalent to oil seal outer surfaces. **Figure 4.19.**

    c. Press oil seal into bearing until seal flange is flat against top of bearing cage. Use the correct size sleeve or seal driver that fits against metal flange of seal. The diameter of the sleeve must be larger than diameter of flange. **Figure 4.20.**

Figure 4.20



    d. Install yoke or flange and pinion nut into pinion.

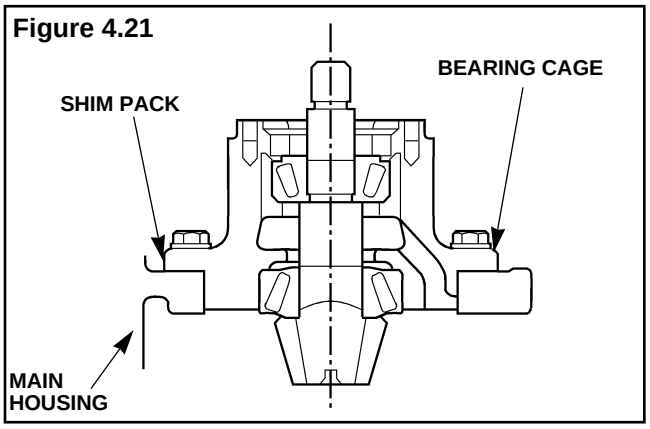
    e. Tighten pinion nut to specified torque after installing pinion bearing cage into main housing of 465-570 lb-ft (630-775 N•m). (T)

Adjust Thickness of Pinion Bearing Cage Shim Pack (Depth of Pinion)

NOTE

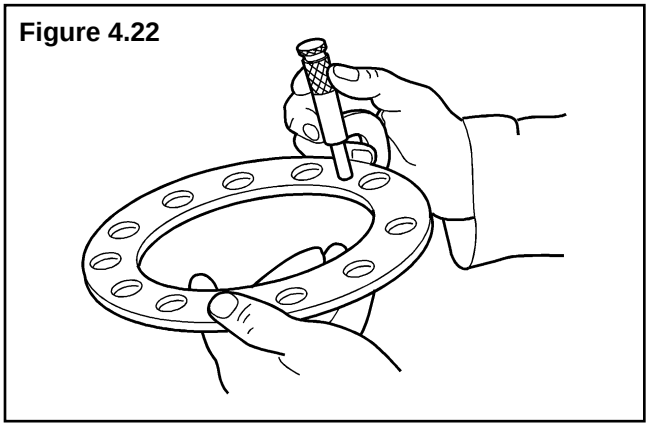
Use this procedure if a new drive pinion and ring gear set is installed or if the depth of the drive pinion has to be adjusted. **Figure 4.21.**

Figure 4.21



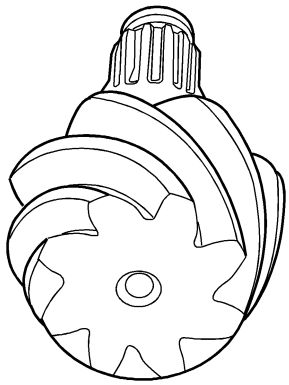
1. Use a micrometer to measure the thickness of the old shim pack that was removed from under the pinion cage. Record the measurement for later use. **Figure 4.22.**

Figure 4.22



2. Record the pinion cone (PC) variation number on the old drive pinion that is being replaced. If the PC variation number cannot be located, assemble the gear set with the shim pack found in step 1. **Figure 4.23.**

Figure 4.23



NOTE

The pinion cone number (PC) can be either 1,000ths of an inch (0.000 inch) or 100ths of a millimeter (0.00 mm). Examples:

PC+3, PC–3, +3 OR -3 = .003 inch (.076 mm)
PC+.03, PC–.03MM , + .03 OR –.03 = .03 mm

- ***To change inches to millimeters, multiply inches by 25.40***
- ***To change millimeters to inches, multiply millimeters by 0.039.***

3. If the old pinion cone number is a plus (+), subtract the number from the old shim pack thickness that was measured in step 2.
4. If the old pinion cone number is a minus (–), add the number to the old shim pack thickness that was measured in step 2.

NOTE

The value calculated in step 3 or 4 is the thickness of the standard shim pack without a variation.

5. Look at the pinion cone (PC) variation number on the new drive pinion that will be installed. Record the number for later use.
6. If the new pinion cone number is a plus (+), add the number to the standard shim pack thickness that was calculated in step 3 or 4.
7. If the new pinion cone number is a minus (–), subtract the number from the standard shim pack thickness that was calculated in step 3 or 4.

NOTE

The value calculated in step 6 or 7 is the thickness of a new shim pack that will be installed.

EXAMPLES	Inches	mm
1.		
Old shim pack thickness	0.030	0.76
Old PC number, PC+2 (+0.05mm)	–0.002	–0.05
Standard shim pack thickness	0.028	0.71
New PC number, PC+5 (+0.13mm)	+0.005	+0.13
New shim pack thickness	0.033	0.84
2.		
Old shim pack thickness	0.030	0.76
Old PC number, PC–2 (–0.05mm)	+0.002	+0.05
Standard shim pack thickness	0.032	0.81
New PC number, PC+5 (+0.13mm)	+0.005	+0.13
New shim pack thickness	0.037	0.94
3.		
Old shim pack thickness	0.030	0.76
Old PC number, PC+2 (+0.05mm)	–0.002	–0.05
Standard shim pack thickness	0.028	0.71
New PC number, PC–5 (–0.13mm)	–0.005	–0.13
New shim thickness	0.023	0.58
4.		
Old shim pack thickness	0.030	0.76
Old PC number, PC–2 (–0.05mm)	+0.002	+0.05
Standard shim pack thickness	0.032	0.81
New PC number, PC–5 (–0.13mm)	–0.005	–0.13
New shim pack thickness	0.027	0.68

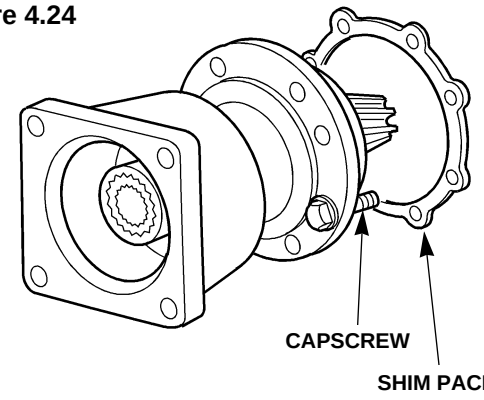
Install Pinion Bearing Cage Assembly on Main Housing

NOTE

Use minimum of three shims in pack. If pack is made from different thickness shims, install thinnest shims on both sides of pack for maximum sealing.

1. Install correct shim pack between bearing cage and main housing. **Figure 4.24.**

Figure 4.24

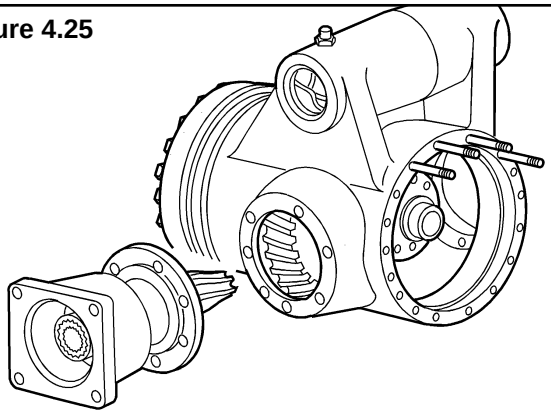


WARNING

Do not hit steel parts with a steel hammer during assembly and installation procedures. Parts can break and cause serious personal injury.

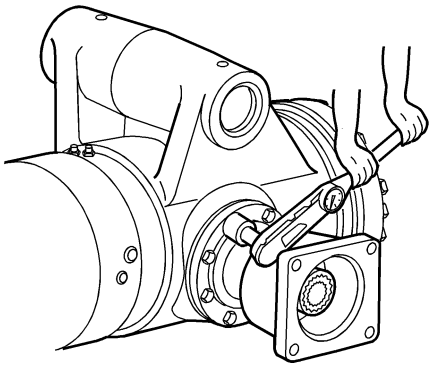
2. Install drive pinion and bearing cage into carrier. If necessary, use rubber, plastic or leather mallet to tap assembly into position. **Figure 4.25.**

Figure 4.25



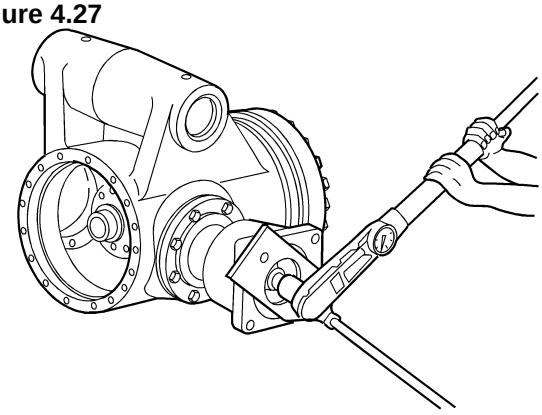
3. Install two capscrews and washers that fasten bearing cage. Tighten to minimum torque of 67 lb-ft (90 N•m). **Figure 4.26.** T

Figure 4.26



4. Install yoke or flange and pinion nut. Fasten yoke or flange with appropriate tool. Tighten pinion nut to minimum specified torque of 465-570 lb-ft (630-775 N•m). **Figure 4.27.** T

Figure 4.27



CAUTION

The fit between input yoke or flange splines and drive pinion is tight. To install yoke or flange into pinion, use pinion nut and appropriate tool to fasten it. Never use hammer or mallet. A hammer or mallet will damage yoke or flange.

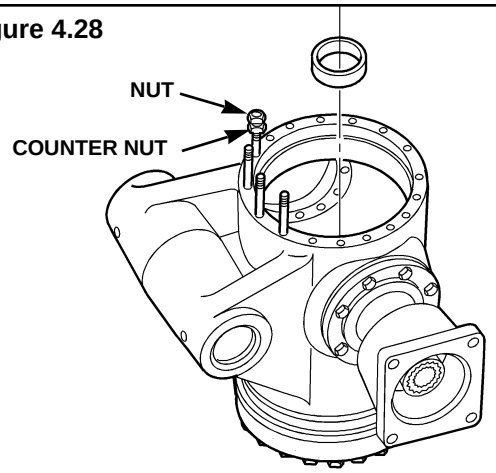
5. If ring gear is mounted on opposite brake housing side, loosen two capscrews that fasten pinion bearing cage. Remove cage and mount it after differential case is assembled.

   If ring gear is mounted on brake housing side, install other capscrews that fasten pinion bearing cage. Tighten the capscrews to a torque of 67-91 lb-ft (91-120 N•m). T

Install Differential Housing Assembly into Main Housing (With Shims)

1. The preload of differential bearings is adjusted by selecting proper shim pack to obtain a torque of 15-35 lb-in (1.7-4.0 N•m). T
2. Install shims. Combine two shims to obtain desired thickness. **Figure 4.28.**

Figure 4.28

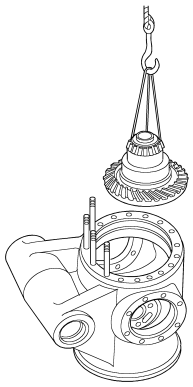


NOTE

Usually a 0.102-0.104 inch (2.60-2.65 mm) shim pack thickness is enough to obtain specified backlash and differential bearing preload.

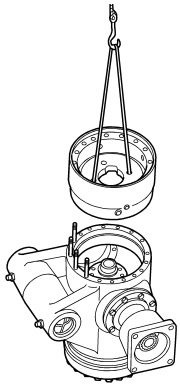
3. Install differential case bearing cup, axle shaft housing and brake housing studs into main housing until the thread is completely attached. Apply Three Bond 1134 liquid gasket material on stud threads. **Figure 4.28.**
4. Install differential case assembly. **Figure 4.29.**

Figure 4.29



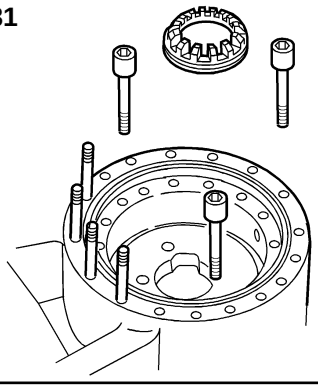
5. Install brake housing and other differential case bearing cup. **Figure 4.30.**

Figure 4.30



6. Install three bolts to adjust differential on brake housing. Tighten to a torque of 19-26 lb-ft (26-36 N•m). **Figure 4.31.** T

Figure 4.31



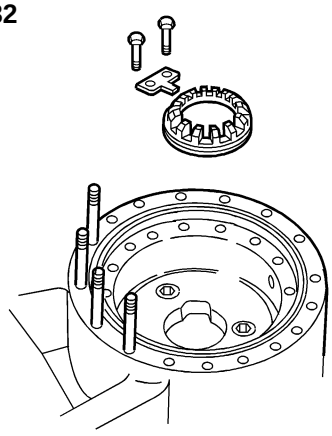
7. Install differential case bearing adjusting nut on brake housing. **Figure 4.31.**
8. Install pinion bearing cage assembly and shim pack.
9. Check backlash, differential preload and teeth contact. See Section 5, “Adjustments.”

WARNING

Small amounts of acid vapor are present when applying some liquid gasket materials during assembly and installation procedures. To prevent possible serious personal injury, make sure there is good ventilation in the work area. If the liquid gasket material gets in eyes, flush eyes with water for 15 minutes. Have eyes checked by doctor.

10. If all adjustments are within specifications, remove brake housing. Apply liquid gasket material to main housing surface.
11. Install three bolts into the brake housing to adjust differential. Tighten them to 19-26 lb-ft (26-36 N•m). T
12. Apply medium torque liquid adhesive, Loctite 241 or Three Bond 1334, to lock capscrews. Install adjusting nut lock and capscrews. Tighten capscrews to 80-115 lb-in (9-13 N•m). **Figure 4.32.** T

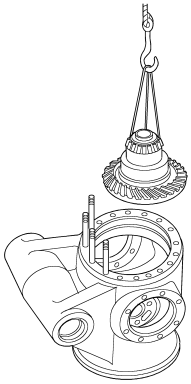
Figure 4.32



Install Differential Housing Assembly into Main Housing (With Adjusting Ring 2 Sides)

1. Install adjusting ring into main housing.
2. Install bearing cup.
3. Install differential case assembly into main housing. **Figure 4.33.**

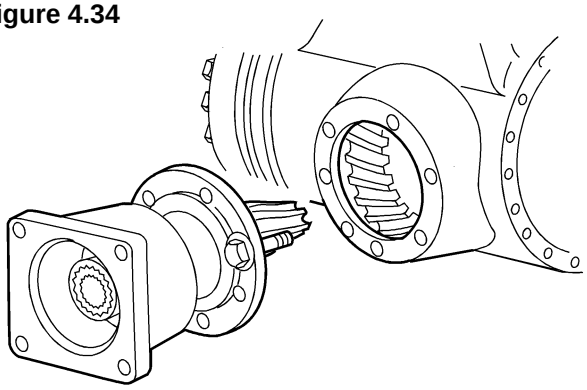
Figure 4.33



4. Install brake housing and other differential case bearing cup. **Figure 4.30.**
5. Install three bolts to adjust the differential on brake housing. Tighten to 19-26 lb-ft (26-36 N•m). **Figure 4.31.** T
6. Install differential case bearings adjusting nut into brake housing. **Figure 4.31.**

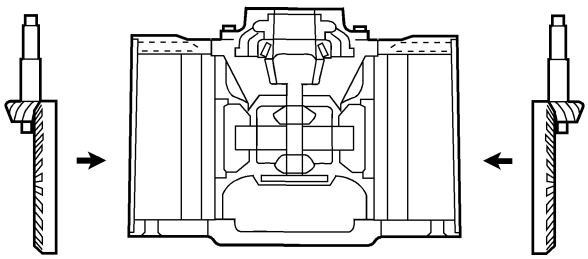
7. Install pinion bearing cage assembly and shim pack. **Figure 4.34.** See “Install Pinion Bearing Cage Assembly on Main Housing,” page 31.

Figure 4.34



8. Adjust adjusting rings with the following procedure. **Figure 4.35.**

Figure 4.35



   a. Tighten ring gear side adjusting ring to eliminate backlash between ring gear and pinion.

   b. Unfasten same adjusting ring from four to five slots.

   c. Tighten opposite side adjusting ring to obtain a preload of 15-35 lb-ft (1.7-4.0 N•m). Discount pinion bearing preload measured before. T

9. Check backlash, differential preload and teeth contact. See Section 5, “Adjustments.”

10. If all adjustments are within specifications, remove brake housing. Apply liquid gasket material to main housing surface.

WARNING

To avoid serious personal injury, be careful when using Loctite. Follow the manufacturer’s instructions for safe use to prevent irritation to eyes and skin. Wash after skin contact. If the Loctite gets in eyes, flush with water for 15 minutes. Have eyes checked by a doctor.

11. Apply high torque liquid adhesive, Loctite 271 or Three Bond 1334, on stud threads.

12. Install studs that fasten brake housing and axle shaft housing to main housing. Tighten studs until resistance is met.

13. Install bearing cup and brake housing into main housing. Align holes at mark made during disassembly.

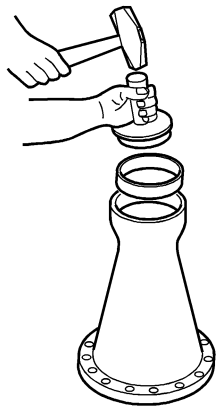
14. Install 3 bolts into the brake housing to adjust differential. Tighten them to 19-26 lb-ft (26-36 N•m). **Figure 4.31.** T

15. Apply medium torque liquid adhesive, Loctite 241 or Three Bond 1334, to lock capscrews. Install adjusting nut lock and capscrews. Tighten capscrews to 80-115 lb-in (9-13 N•m). T

Assemble Axle Shaft

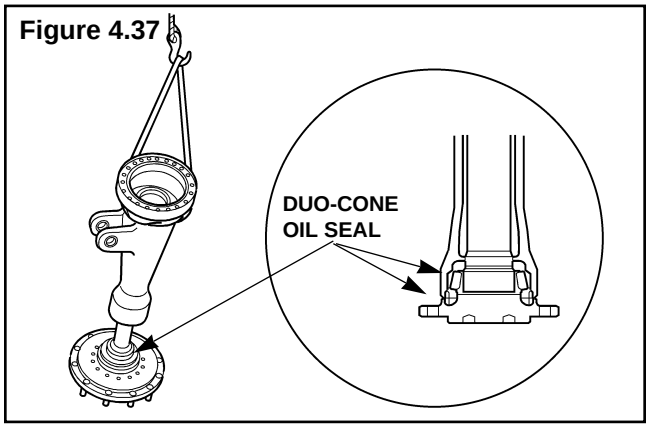
1. Use correct size sleeves to install cups into bores in axle shaft housing until cups are flat against bottom of bores. **Figure 4.36.**

Figure 4.36



2. Install Duo-Cone oil seal into axle shaft and into axle shaft housing bore as specified on page 18. **Figure 4.37.**

Figure 4.37



3. With a correct size sleeve, use a press to install flange side cone bearing. Install axle shaft into axle shaft housing. **Figure 4.37.**

Assemble Trumpet Assembly

WARNING

Observe all WARNINGS and CAUTIONS provided by the press manufacturer concerning press operation to avoid serious personal injury and possible damage to components during assembly and installation procedures.

1. Use press to install new planetary pin into spider. Make sure proper dimensions are used and holes are aligned. **Figures 4.38 and 4.39.**

Figure 4.38

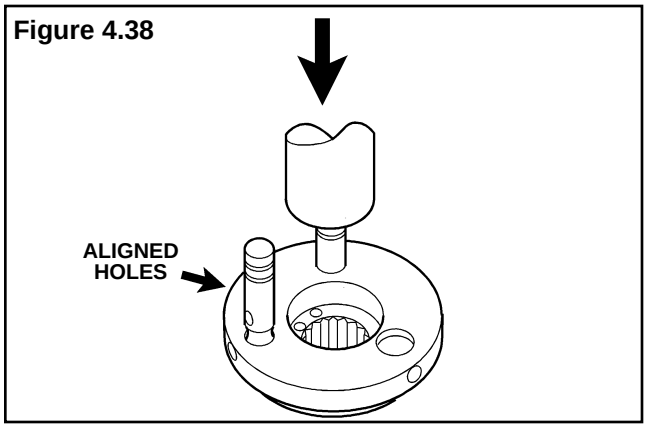
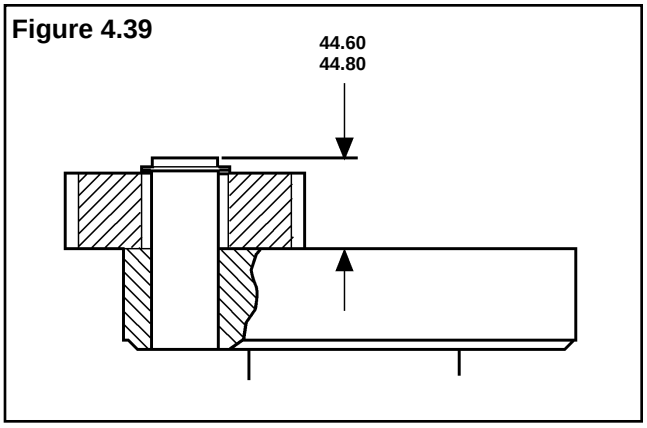


Figure 4.39



WARNING

To avoid serious personal injury, be careful when using Loctite. Follow the manufacturer's instructions for safe use to prevent irritation to eyes and skin. Wash after skin contact. If the Loctite gets in eyes, flush with water for 15 minutes. Have eyes checked by a doctor.

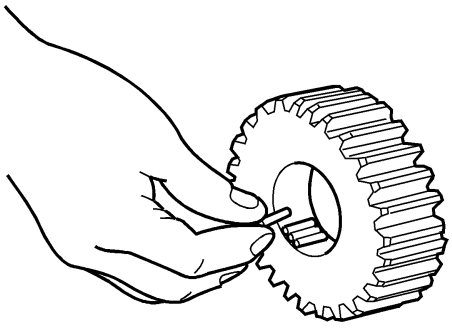
2. Apply Medium Torque liquid adhesive, Loctite 241 or Three Bond 1334, to threads of planetary gear axle lock capscrews. Install and tighten to 17-23 lb-ft (23-31 N•m). T

CAUTION

Rollers must come from the same manufacturer and have the same tolerance range. Replace spacers and washers when a new roller is used.

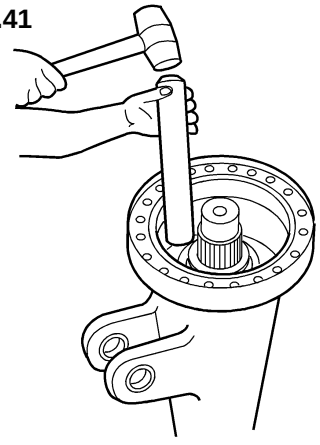
3. Apply grease, Shell-71032 Alvania EP-2 or Texaco - 995 Multifak EP-2, on each gear hole. Install rollers and spacers into planetary gears. **Figure 4.40.**

Figure 4.40



4. Install bearing cone. **Figure 4.41.**

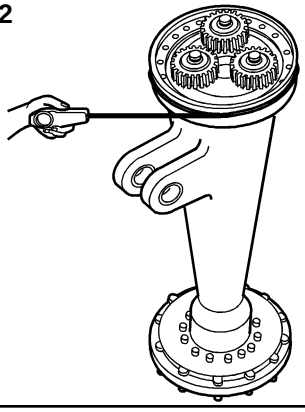
Figure 4.41



5. Install planetary spider and axle shaft bearing adjusting nut.
6. Measure trumpet flange radius. With a spring scale, check the trumpet assembly preload before tightening adjusting nut.

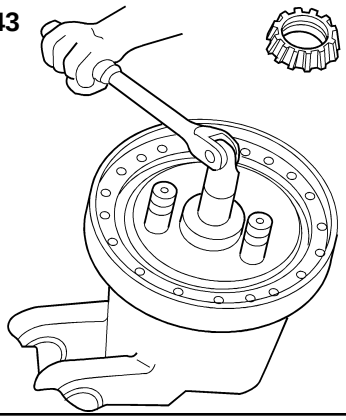
   The value will be obtained by multiplying the number read on the spring scale dial by the flange radius. Make note of the value. **Figure 4.42.**

Figure 4.42



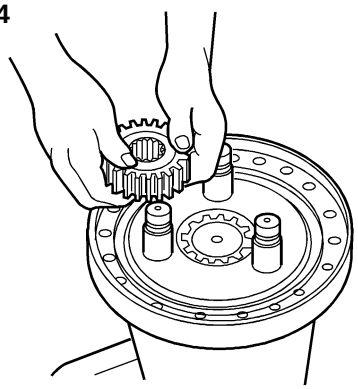
7. Tighten adjusting nut with special tool shown on page 60. At the same time, manually rotate the trumpet to assure a correct fit between bearing cups and cones and get desired preload. **Figure 4.43.**

Figure 4.43



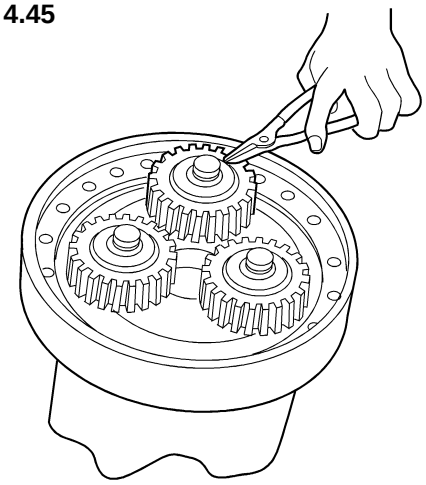
8. Check trumpet assembly preload and subtract value obtained before tightening adjusting nut. Value must be 15-35 lb-in (1.7-4 N•m). T
9. Apply Medium Torque liquid adhesive, Loctite 241 or Three Bond 1334, on adjusting nut lock capscrew threads. Install adjusting nut lock capscrew. Tighten to 17-23 lb-ft (23.0-30.5 N•m). T
10. Install inner washer, planetary gears and rollers into flange. **Figure 4.44.**

Figure 4.44



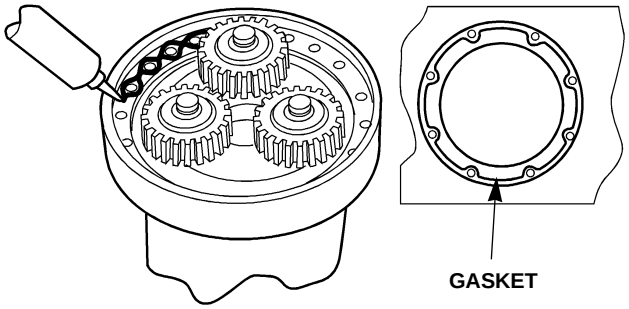
11. Install outer washers.
12. With correct pliers, install snap rings. **Figure 4.45.**

Figure 4.45



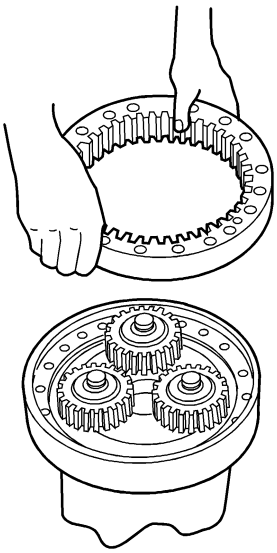
13. Apply liquid gasket material on contact surfaces of trumpet and ring. **Figure 4.46.**

Figure 4.46



14. Install ring gear into trumpet. Use reference marks made during disassembly to align holes and contact surface. **Figure 4.47.**

Figure 4.47



Assemble Hydraulic Apply Brake Housing Assembly

NOTE

- ***To assemble three function brake, see page 39.***
- ***To assemble ball and ramp brake, see page 43.***

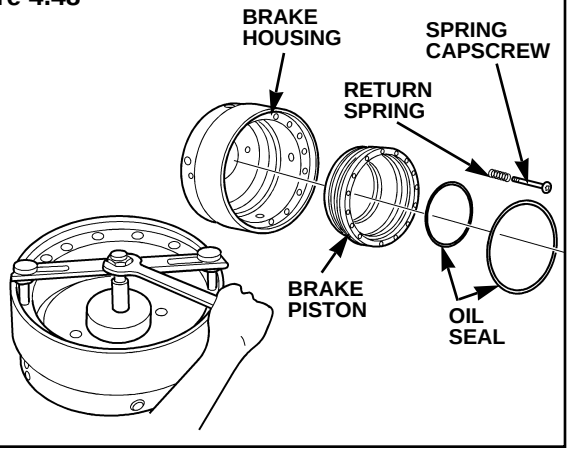
1. Check to see if the piston lodging surfaces on brake housing is free of sharp edges, nicks and burrs. Repair any damage if possible or replace the part.
2. Repeat Step 1 on outer surfaces of brake piston.
3. Apply a thin film of oil, SAE W140 or SAE 90, to piston and bore. Apply a dense layer of oil to brake housing chamfer.
4. Carefully install piston oil seals.

NOTE

Before pressing piston into brake housing, rotate piston 15 to 20 degrees. If piston does not turn easily, disassemble the piston and find the cause of the interference.

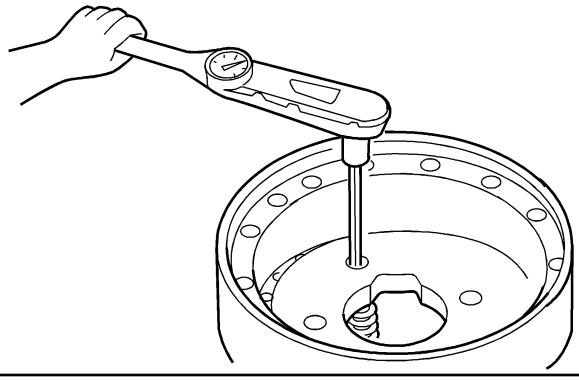
5. With a manual press, carefully install piston into brake housing. Do not damage oil seals. If there is resistance in installing the piston, do not proceed. **Figure 4.48.**

Figure 4.48



6. Apply high torque liquid adhesive, Loctite 271 or Three Bond 1305, to capscrew threads. Install return springs and return spring capscrews. Tighten to 80-115 lb-in (9.0-13.0 N•m). T **Figure 4.49.**

Figure 4.49



Hydraulic Apply Brake Housing Functional Test

NOTE

- ***This test procedure is only for the hydraulic apply brake system.***
- ***To perform this test, it is necessary to use a device which permits the observation of possible leaks through oil seals and if the piston return system is working. For an accurate evaluation, the device must allow piston displacement of 0.157 to 0.197 inch (4-5 mm).***

1. Connect brake housing assembly into hydraulic system equipped with 1000 psi (69 bar) manometer.
2. Activate the cylinder at least five times with 600 psi (41.4 bar). Check for leaks.
   - If there are no leaks, proceed to Step 3.
   - If there are leaks, disassemble brake housing assembly, find and correct the problem.
3. Wait five minutes, then apply 600 psi (41.4 bar) to the cylinder again.

- If there are no leaks, proceed to Step 4.
- If there are leaks, disassemble brake housing assembly, find and correct the problem. Repeat Steps 1 to 3.

4. Wait five minutes, then apply 75 to 110 psi (5.1 to 7.6 bar) to the cylinder again.
   - If there are no leaks, the assembly is assembled correctly.
   - If there are leaks, find and correct the problem. Repeat the test again.

Assemble Three Function Brake Housing Assembly

NOTE
Before assembling brake housing assembly, make sure that all surfaces and bores of brake housing and piston are free of dirt, burrs and nicks.

1. Select piston shim pack with the following procedure:
   a. Position parts of piston assembly in a press. Measure the dimension “A” under 441 lb (200 Kg) pressure. **Figure 4.50.**
   b. Measure the dimension “B”. **Figure 4.51.**

Figure 4.50

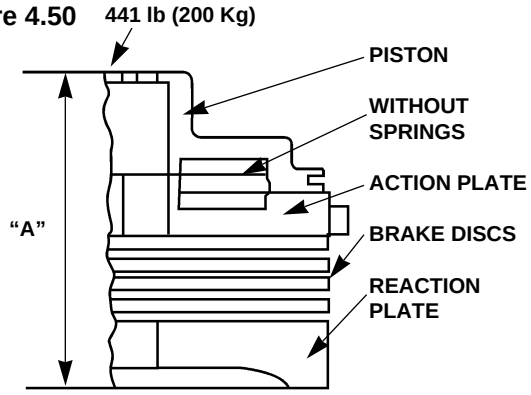
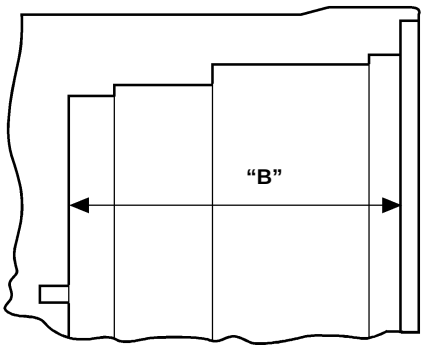


Figure 4.51



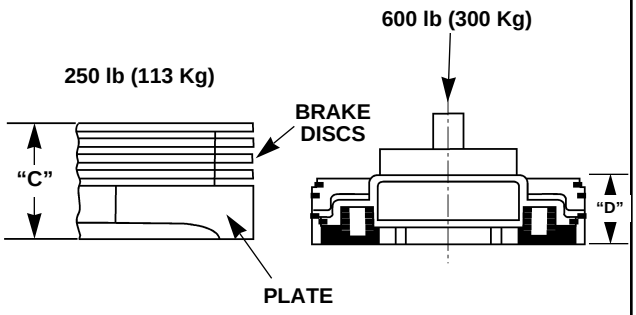
   c. The shim pack thickness is the difference between dimension “B” and dimension “A” minus 0.06 in. (1.5 mm):

      B-A-0.06 in. (1.5 mm) = shim pack thickness

   d. If brake piston is assembled, the shim pack thickness, under press pressure of 441 lbs (200 Kg), is the difference between dimension “B” minus the sum of dimensions “C” and “D” minus 0.06 in. (1.5 mm):

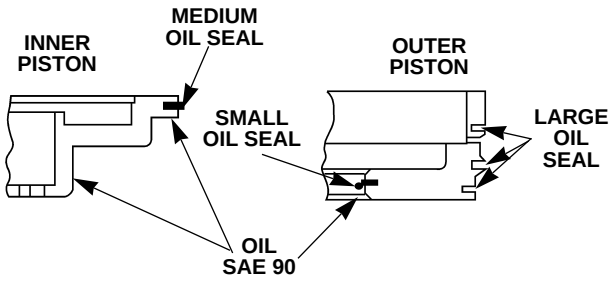
      B-(C+D) -0.06 (0.15) = shim pack thickness. **Figure 4.52.**

Figure 4.52



2. Lubricate internal brake housing surfaces, inner and outer piston surfaces and oil seal bores with SAE 90 oil. **Figure 4.53.**

Figure 4.53

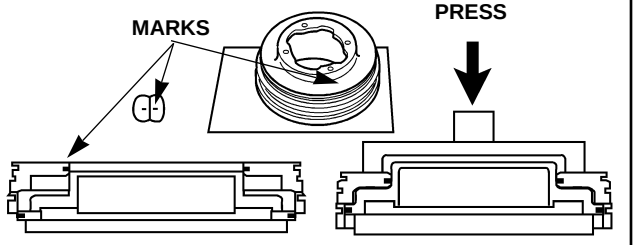


NOTE

Each piston assembly has three different sizes of oil seals: three large, one medium, one small.

3. Install medium oil seal into inner piston bore and install the small oil seal into the outer piston bore. **Figure 4.53.**
4. ONLY use a manual press to install inner piston into outer piston. Be careful not to damage oil seals. Do not force the inner piston assembly. **Figure 4.54.**

Figure 4.54

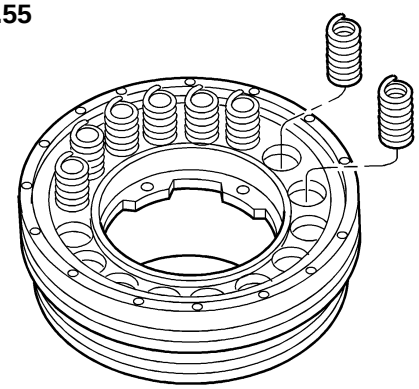


NOTE

Rotate pistons until marks are aligned. If inner piston does not rotate easily, disassemble it and find the cause. **Figure 4.54.**

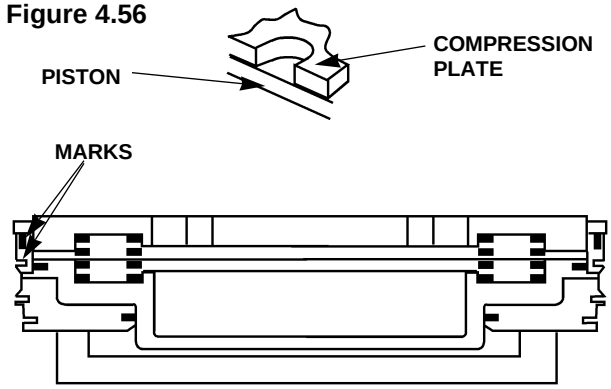
5. Install springs into bores in inner piston. **Figure 4.55.** For brake with 12 springs, jump one bore each three. **Figure 4.55.**

Figure 4.55



6. Install compression plate on piston. Correctly align the fastener holes. Use marks on piston and lock pin slot. **Figure 4.56.**

Figure 4.56



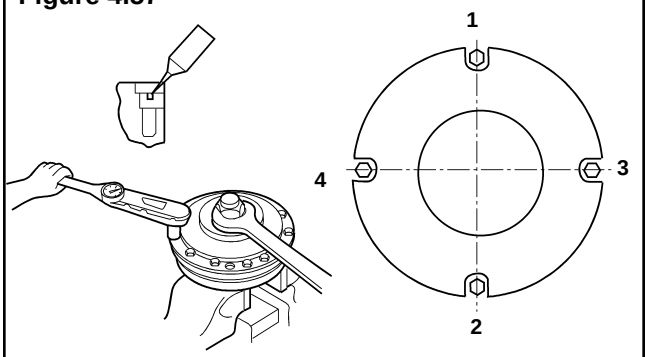
7. Apply pressure to the compression plate until it is flat against the piston.

⚠ WARNING

To avoid serious personal injury, be careful when using Loctite. Follow the manufacturer's instructions for safe use to prevent irritation to eyes and skin. Wash after skin contact. If the Loctite gets in eyes, flush with water for 15 minutes. Have eyes checked by a doctor.

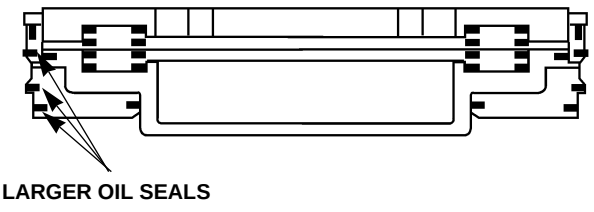
8. Apply medium torque liquid adhesive, Loctite 241 or Three Bond 1334 in threaded external piston bolt holes. Install action plate bolts as shown in **Figure 4.57** and apply a pretorque of 30 lb-in (3.3 N•m). Tighten to specified torque of 120-140 lb-in (13.5-16 N•m).

Figure 4.57



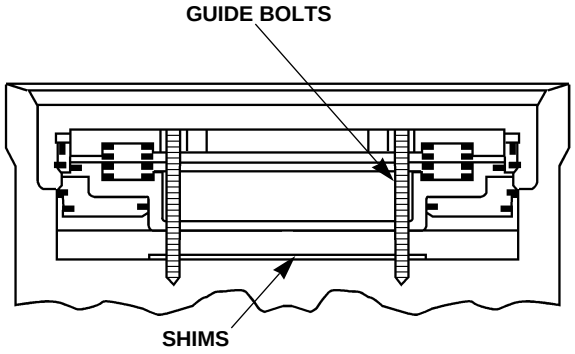
9. Install three larger oil seals into outer piston. Make sure the oil seals fit in the bores. **Figure 4.58.**

Figure 4.58



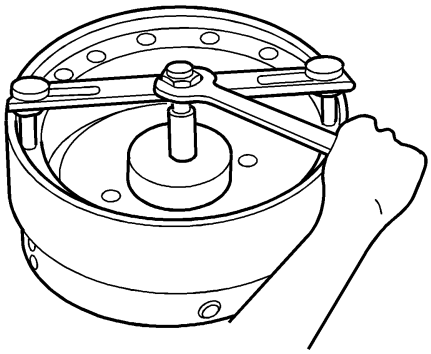
10. Install shim pack into brake housing. Use bolts to align holes. **Figure 4.59.**

Figure 4.59



11. Remove guide bolts and manually install brake piston assembly into brake housing. Rotate piston assembly 15 to 20 degrees. The rotation must be easy and without resistance. If there is any resistance, disassemble the brake piston assembly and find the cause.
12. Use bolts as guide and align piston and holes. Use marks made during disassembly as reference. **Figure 4.60.**

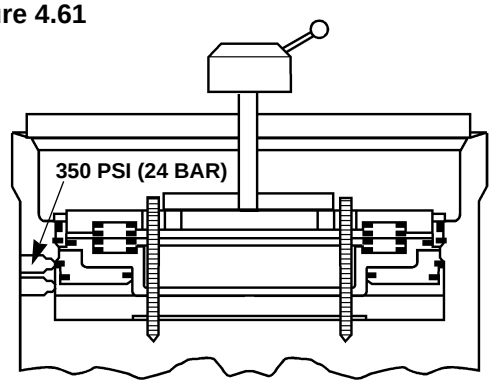
Figure 4.60



13. With a manual press on brake housing, apply pressure to brake piston until the springs compress. Make sure oil seals fit in bores. **Figure 4.60.**

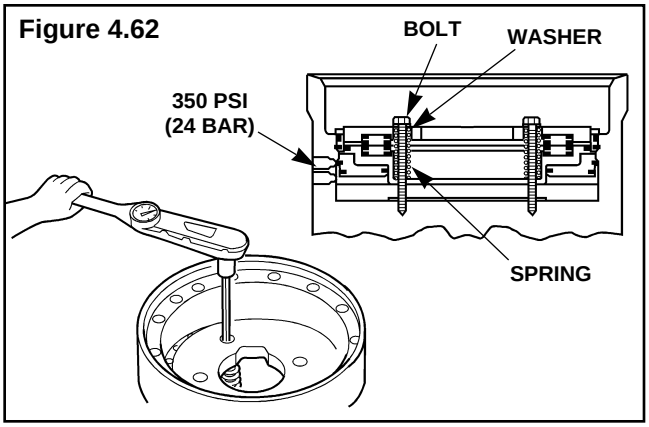
14. With piston still compressed, apply 350 psi (24 bar) into parking brake to make sure oil seals fit in bores. **Figure 4.61.**

Figure 4.61



15. Keep the parking brake under 350 psi (24 bar) pressure and remove the manual press and guide pins.
16. Apply medium torque liquid adhesive, Loctite 241 or Three Bond 1334, to return spring holes and bolt threads. Install return springs, washers and return spring bolts into brake housing. Tighten bolts to 80-115 lb-in (9-13 N•m). **Figure 4.62.** T

Figure 4.62



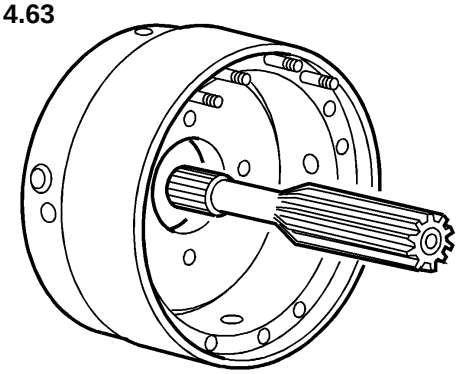
NOTE

Use same procedure to install other brake piston assemblies into main housing.

Assemble Ball and Ramp Brakes, Brake Discs, Reaction Plate and Pins

1. Install sun gear. **Figure 4.63.**

Figure 4.63

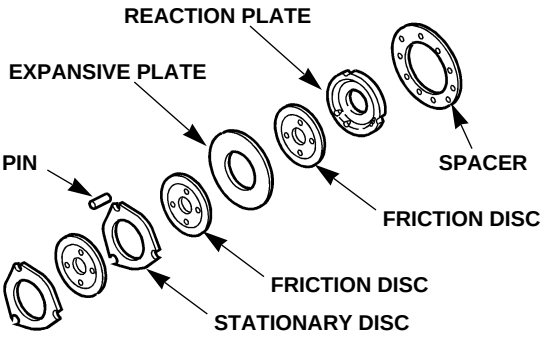


NOTE

After assembly, friction disc lubrication holes must be perfectly aligned.

2. Install friction and stationary discs alternately. Make sure friction disc is against brake piston.
3. For ball and ramp brakes, discs must be installed alternately and a friction disc must be on each side of the expansive plate. **Figure 4.64.**

Figure 4.64

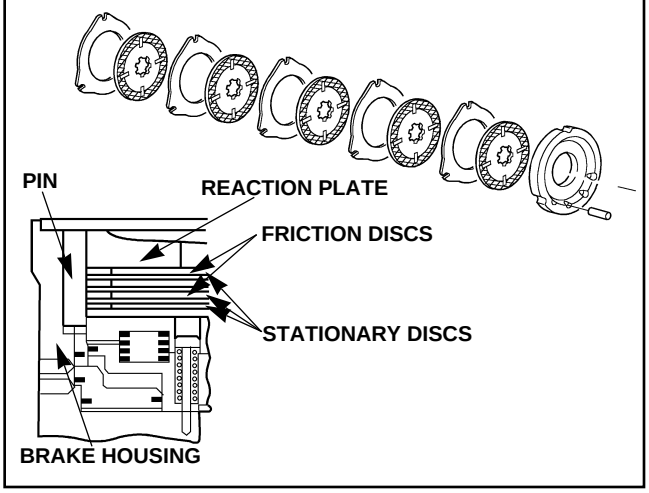


4. Install stationary disc lock pins.
5. Install reaction plate with lubrication hole on down side of axle.
6. If there is an outer spacer, install it on brake housing surface. Use liquid gasket material.

Assemble Three Function Brakes, Brake Discs, Reaction Plate and Pins

1. Lubricate all brake components with same oil specified for axle. See page 53.
2. Install sun gear. **Figure 4.63.**
3. Apply 350 psi (24 bar) into parking brake.
4. Install friction and stationary discs, guide pins and reaction plate. **Figure 4.65.**

Figure 4.65



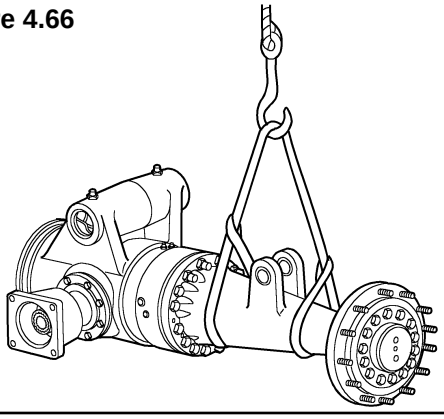
Install Housing Assembly into Main Housing

NOTE

If axle is equipped with three function brake, keep parking brake pressurized.

1. Install housing assembly. Make sure that the mark made during disassembly is correctly positioned to ensure alignment of the fastener holes. **Figure 4.66.**

Figure 4.66

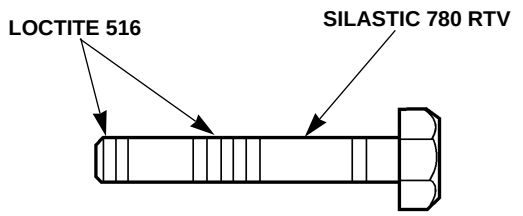


2. Install capscrews and nuts that fasten housing to main housing.
   - Tighten grade 12.9 capscrew 170-200 lb-ft (230-271 N•m). T
   - Tighten grade 10.9 capscrew 135-170 lb-ft (183-230 N•m). T
   - Tighten stud nuts 120-150 lb-ft (160-205 N•m). T
3. Release pressure from parking brake.
4. Apply liquid gasket material, Loctite 515 or Three Bond 1134, on surface of cover that fastens to main housing and on capscrew threads. Install cover and capscrews on main housing. Tighten capscrews to 20-27 lb-ft (27-36 N•m). T

Assemble Three Function Brake Release Bolts and Sleeves

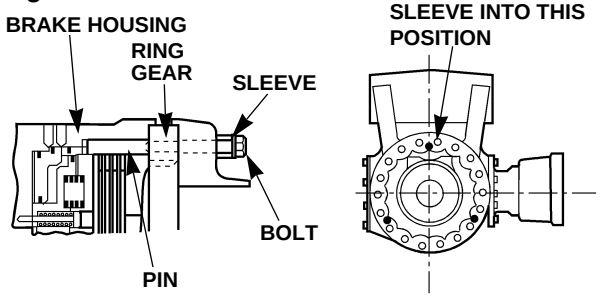
1. Apply Loctite 516 on bolt threads. **Figure 4.67.**

Figure 4.67



2. Apply liquid gasket material, Silastic 780 RTV Dow Corning, on non-threaded bolt shaft. **Figure 4.67.**
3. Install bolts and sleeves. Tighten to 25-34 lb-ft minimum (34-46 N•m). **Figure 4.68.** T
   - Assemble 2 larger bolts, 3.346 in. (85 mm) with larger sleeves, 1 in. (26 mm)
   - Assemble shorter bolt, 3.070 in. (78 mm) with shorter sleeve, 0.750 in. (19 mm).

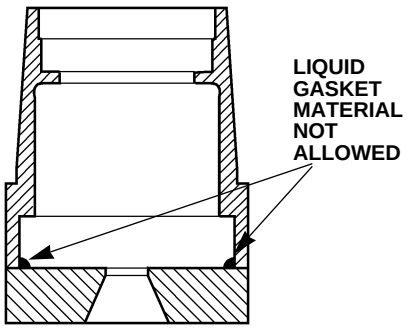
Figure 4.68



Assemble Ball and Ramp Brake Cylinder Assembly and Install on Main Housing

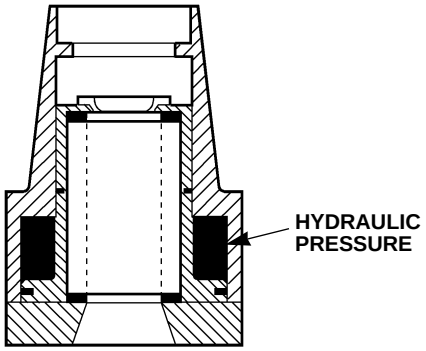
1. Apply liquid gasket material FAG-3 on brake cylinder surface that fastens to brake cylinder support. Assemble brake cylinder, oil seals, piston and brake cylinder support. Tighten capscrews that fasten brake cylinder support 19-26 lb-ft (26-36 N•m). **Figure 4.69.** T

Figure 4.69



2. While out of the axle, connect cylinder assembly to hydraulic system. Apply 400 psi (27.6 bar) pressure to compress spring until piston is against brake cylinder. Repeat this operation four to five times to make sure there is no leakage. **Figure 4.70.**

Figure 4.70

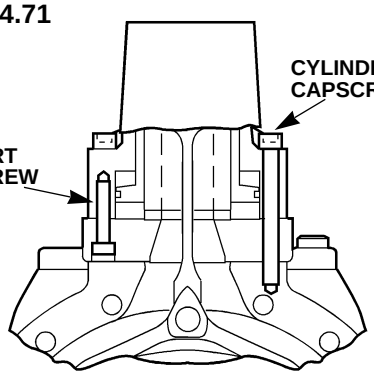


CAUTION

Do not use brake fluid in the hydraulic system. Use Shell Donax TD or Shell Tellus 32 or equivalent.

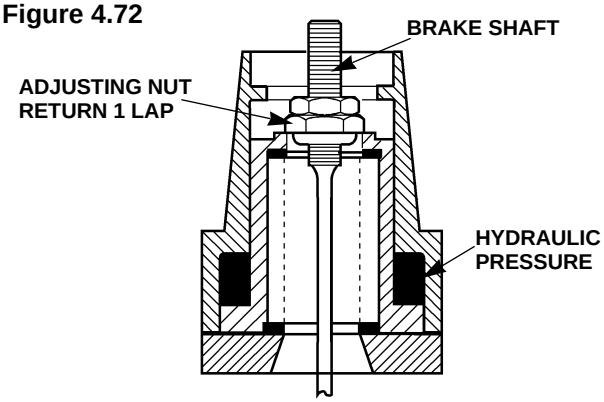
3. Install brake cylinder assembly onto main housing. **Figure 4.71.**

Figure 4.71



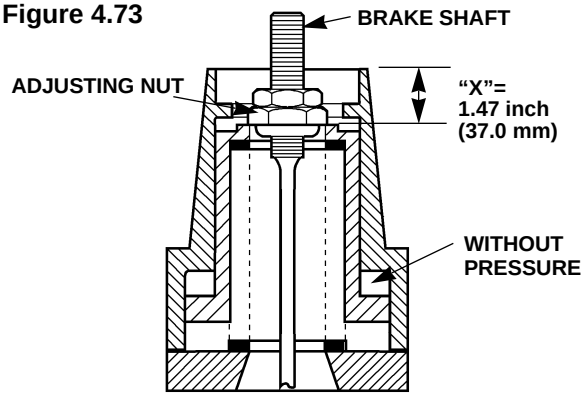
4. While the cylinder is pressurized with 400 psi (27.6 bar), apply liquid adhesive, Loctite 221 or Three Bond 1341, on threads of brake shaft. Install adjusting nut until it rests against piston. DO NOT TIGHTEN ADJUSTING NUT. Loosen the adjusting nut one full turn. **Figure 4.72.**

Figure 4.72



5. Release cylinder pressure to ZERO so piston returns back against adjusting nut. Check dimension “X” as shown in **Figure 4.73.**

Figure 4.73



If dimension “X” is smaller than 1.47 inch (37.0 mm), tighten adjusting nut until the dimension is reached. If dimension gets larger, unfasten the nut. This adjustment must be made with piston activated.

6. After 1.47 inch (37.0 mm) dimension is obtained, apply specified pressure to brake and check the brake torque on pinion as shown in chart.

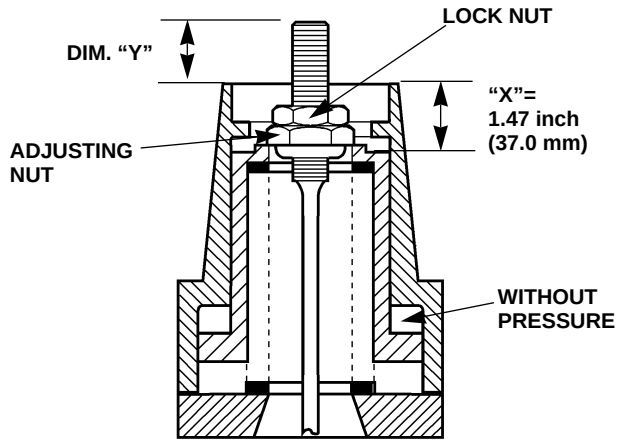
Torque Reduction	Disc No.	Pressure	Torque
PRA-382 17.08:1	06	275 psi min (19 bar min)	950-1200 lb-ft (1288.0-1559.0 N•m)
PRA-353 46.00:1	06	275 psi min (19 bar min)	350-500 (474.5-678.0 N•m)

NOTE

To obtain the desired brake torque, fasten or unfasten the adjusting nut. For each 0.04 inch (1 mm) turned on dimension "X", the variation in torque is 4%.

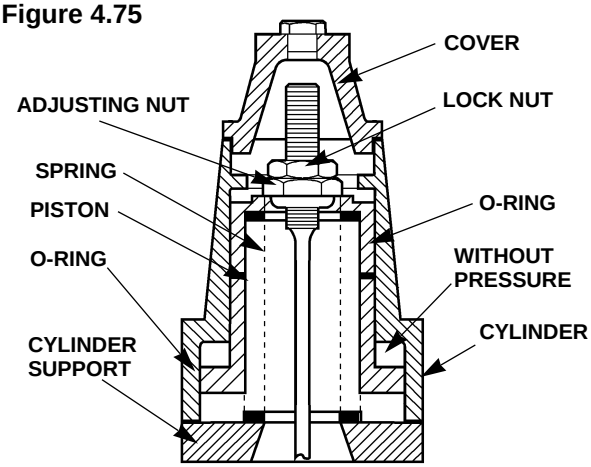
7. After obtaining the desired brake torque, install nut lock as shown in **Figure 4.74.** Tighten to 60-90 lb-in (80-120 N•m).

Figure 4.74



8. Install cover. **Figure 4.75.**

Figure 4.75



9. The dimension "Y" must be equal with ± 0.02 inch (0.5 mm) on each side. If dimension is larger on one of the sides after adjustment, disassemble and find the cause.

NOTE

Do not check the brake torque before the wheel has turned at least two times with the brake activated.

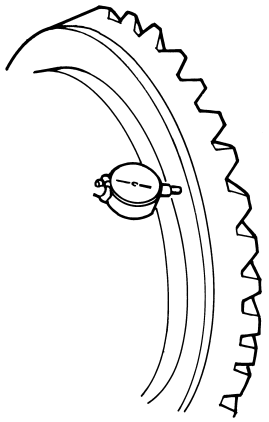
Check Ring Gear Runout Specification: 0.008 inch (0.20 mm)

⚠ *WARNING*

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. Attach magnetic base dial indicator to mounting flange of main housing. **Figure 5.1.**

Figure 5.1



2. Set dial indicator so plunger or pointer is against back surface or ring gear. **Figure 5.1.**
3. Set dial indicator to **ZERO**.
4. Rotate differential and ring gear assembly while you read dial indicator. Ring gear runout must not exceed 0.008 inch (0.20 mm). If runout exceeds specifications, remove differential and ring gear assembly from main housing.
5. Check differential parts including carrier for problem that caused ring gear runout to exceed specifications. Repair or replace parts if necessary.

⚠ *CAUTION*

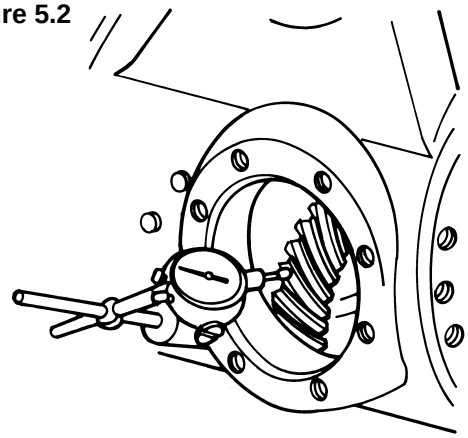
Shock load failure will distort the differential case flange and transfer damage to ring gear. In this case, differential carrier must be discarded.

6. After parts are repaired or replaced, install main differential case and ring gear assembly into carrier. Repeat steps 1 to 5.

Adjust Pinion and Ring Gear Backlash Specification: 0.005-0.015 inch (0.13-0.38 mm)

1. Attach dial indicator on mounting flange of carrier.
2. Set dial indicator so plunger is against a tooth surface. **Figure 5.2.**
3. Set dial indicator to **ZERO**.

Figure 5.2



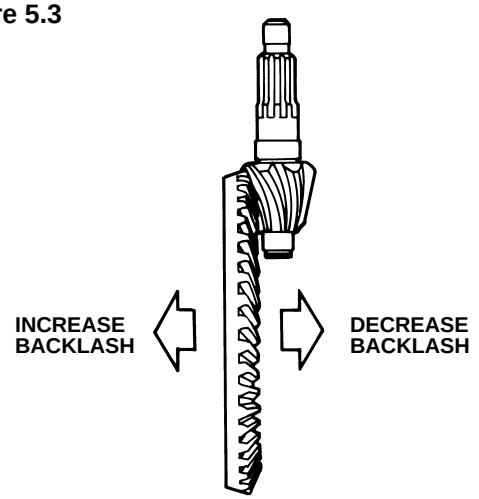
NOTE

- ***When you adjust backlash, only move ring gear. Do not move drive pinion.***
- ***If you are using old ring gear and pinion, it is recommended that you maintain original backlash.***

4. Hold drive pinion in position.
5. While you read dial indicator, rotate differential and ring gear a small amount in both directions against teeth of the drive pinion. If backlash reading is within specified range of 0.005-0.015 inch (0.13-0.38 mm), continue by checking tooth contact patterns. If backlash reading is not within specifications, adjust backlash as needed.

6. Loosen one bearing adjusting ring one notch, then tighten opposite ring the same amount to keep differential roller bearing preload. **Figure 5.3.**

Figure 5.3



NOTE

When you adjust backlash, only move ring gear. Do not move drive pinion.

- ***Backlash is increased by moving ring gear away from drive pinion.***
- ***Backlash is decreased by moving ring gear toward drive pinion.***

7. Repeat steps two to six until backlash is within specifications. Record setting for use when you adjust pinion bearing preload.

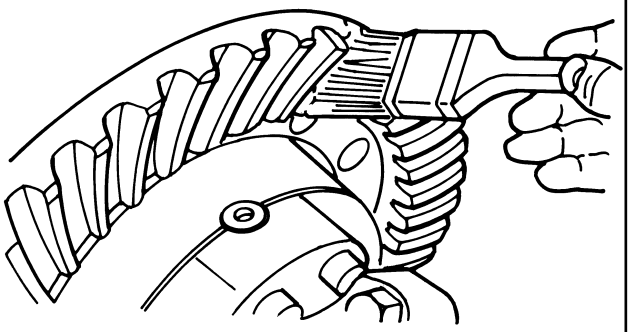
Teeth Contact Patterns

In the following procedures, movement of the contact pattern along length of tooth is indicated as toward the “heel” or “toe” of the ring gear. **Figure 5.4.**

Verification Procedure

1. Apply a marking compound to approximately 12 teeth of ring gear. Rotate ring gear so that the 12 gear teeth are next to drive pinion. **Figure 5.5.**

Figure 5.5



2. Apply load on ring gear with wood pry bar. Rotate gear forward and backward so 12 gear teeth go past the drive pinion six times to get contact patterns. Repeat if needed to get a more clear pattern. **Figure 5.6.**

Figure 5.6

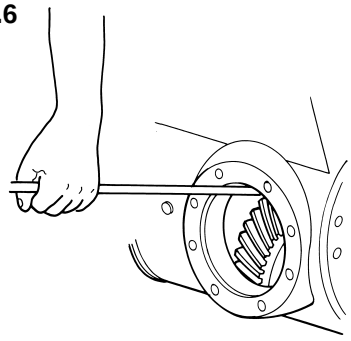
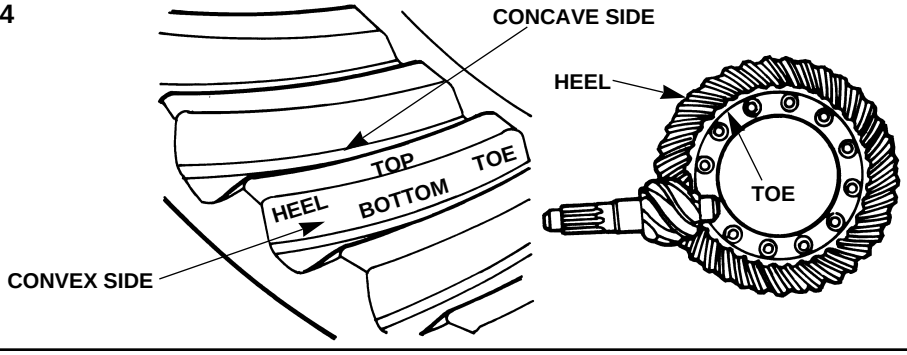
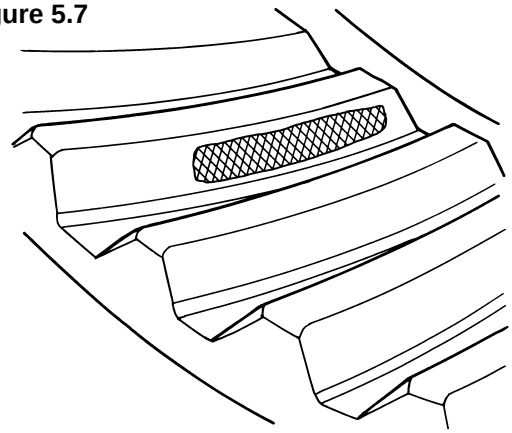


Figure 5.4



3. Compare contact patterns on ring gear teeth to good contact patterns in **Figure 5.7.** If contact patterns are not satisfactory, go to Incorrect Contact Patterns on this page.

Figure 5.7

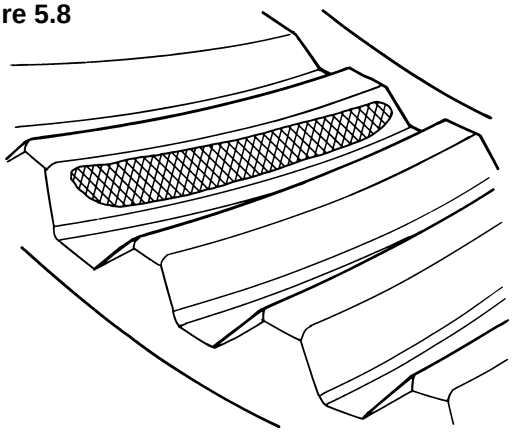


Correct Contact Patterns

The location of a good hand-rolled contact pattern for a new gear set is toward toe of gear tooth and in center, between top and bottom of tooth. **Figure 5.7.**

When carrier is being operated under load, pattern will extend approximately the full length of tooth. The top of pattern will be near top of gear tooth. **Figure 5.8.**

Figure 5.8



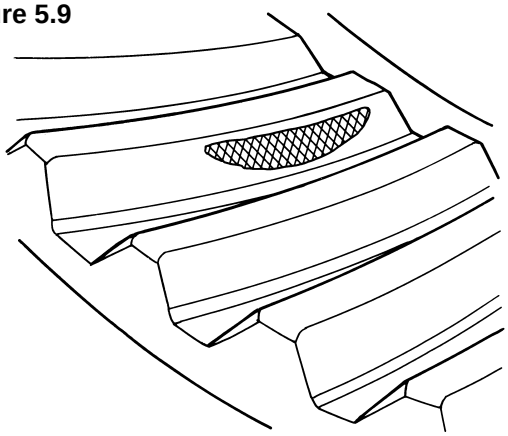
The location of a good hand-rolled pattern for a used gears set must match wear pattern in ring gear. The contact pattern will be smaller in area than the wear pattern.

Incorrect Contact Patterns

High Contact Pattern:

A high contact pattern indicated that drive pinion was not installed deep enough into carrier. **Figure 5.9.**

Figure 5.9



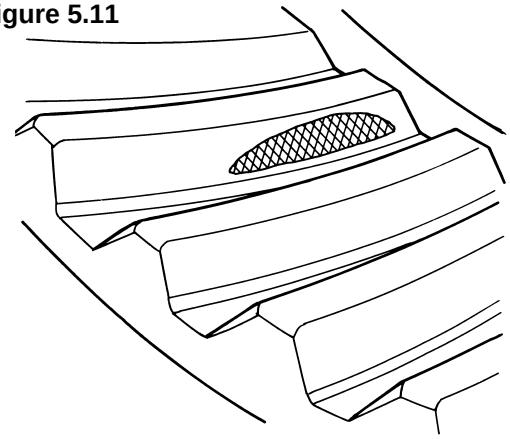
- To correct a high-contact pattern, decrease thickness of shim pack under bearing cage. This will move drive pinion toward ring gear. **Figure 5.10.**

Figure 5.10

Deep Contact Pattern

A deep contact pattern indicates that the drive pinion was installed too far in the carrier.
Figure 5.11.

Figure 5.11



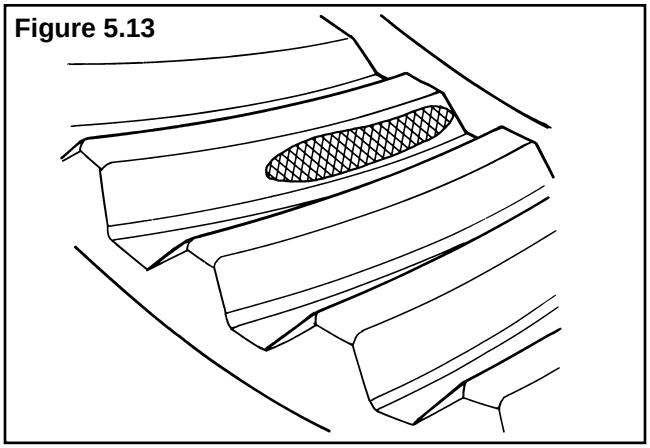
- To correct a deep contact pattern, increase thickness of shim pack under bearing cage. This will move the drive pinion away from the ring gear. **Figure 5.12.**

Figure 5.12

Variations Along Length of Gear Teeth

Adjust backlash of ring gear within specification range to move contact patterns to correct location along length of gear teeth.When toe contact pattern indicates that backlash is very low and gear is too close to drive pinion: **Figure 5.13.**

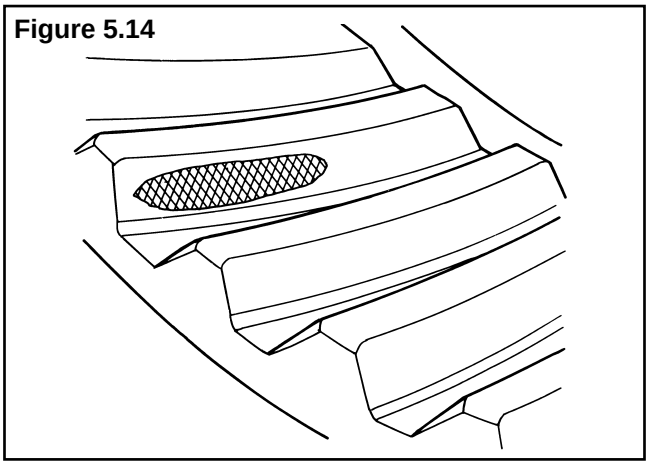
Figure 5.13



- Withdraw ring gear by decreasing shim pack thickness or loosening the gear side adjusting ring and tightening opposite side adjusting ring.

  When heel contact pattern indicates that backlash is very high and gear is too far away from drive pinion: **Figure 5.14.**

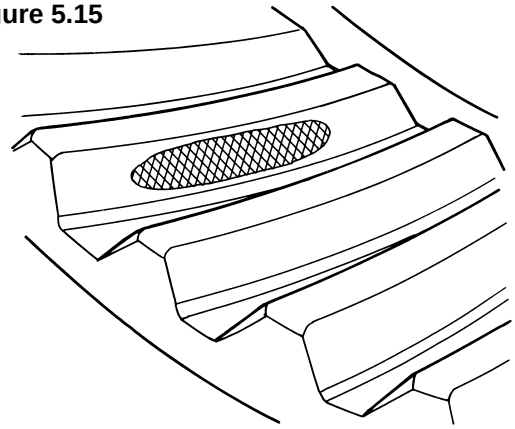
Figure 5.14



- Approach ring gear by increasing shim pack thickness or loosening gear opposite side adjusting ring and tightening gear side adjusting ring.

An acceptable contact pattern is centralized between toe and heel along the length of gear teeth. **Figure 5.15.**

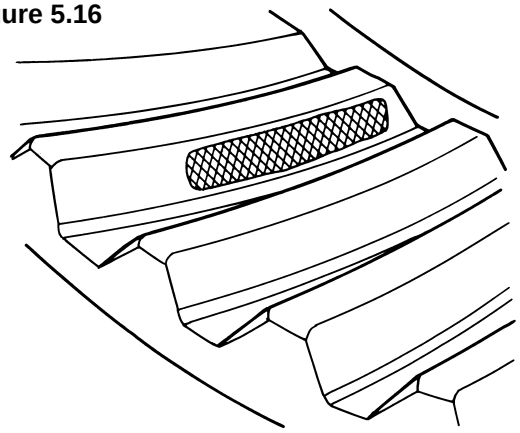
Figure 5.15



In cases where it is not possible to get a good contact pattern, the contact pattern shown in **Figure 5.15** is acceptable. If the acceptable contact pattern is not achieved, change the ring gear and pinion set.

Figure 5.16 indicates a good contact pattern. It is toward the toe and centralized between the top and bottom of the gear teeth.

Figure 5.16



Replace Lubricant

1. Install and tighten drain plug in central housing and brake housing. (T)
2. Clean area around fill/level plug. Remove fill/level plug from carrier inspection cover.

WARNING

- ***Use only the type of fluid specified by the equipment manufacturer. Do not use or mix different types of fluid. The wrong fluid will damage the rubber parts of the assemblies which could cause loss of braking and serious personal injury.***
- ***Do not reuse fluid. Used fluid can be contaminated and can cause incorrect operation which could result in serious personal injury.***

3. Add specified oil until oil level is even with bottom of fill/level hole. See Section 6, “Specifications.”
4. Install and tighten fill/level plugs. (T)
5. Road test vehicle in an unloaded condition for one-two miles (1.6-3.2 km) at speeds not more than 25 mph (40 kph). Check the lubricant levels and the torque of all fasteners.

PRA 352 Series Planetary Drive Axle
Oil Change Intervals and Specifications

Off-Highway Operation Intervals ①				Meritor Specification	Military Specification	Oil Description
Initial Oil Change	Check Oil Level	Petroleum Oil Change	Synthetic Oil Change			
100 operating hours ① or 1240-3100 miles (2000-5000 km) (whichever comes first)	250 operating hours ①	1,500 operating hours or twice a year (whichever comes first)	—	0-84	—	Petroleum Base SAE 10W, 20W or 10W/30 ②

NOTES:

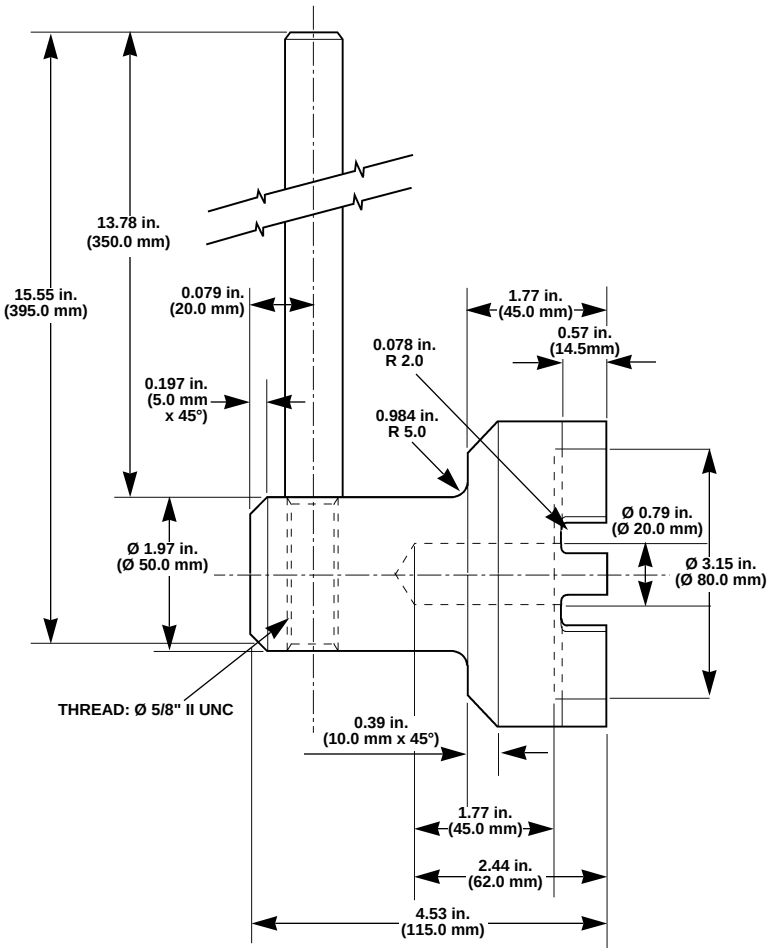
① The checking interval depends on the individual operating conditions, speeds and loads. Severe operating conditions may require more frequent intervals.

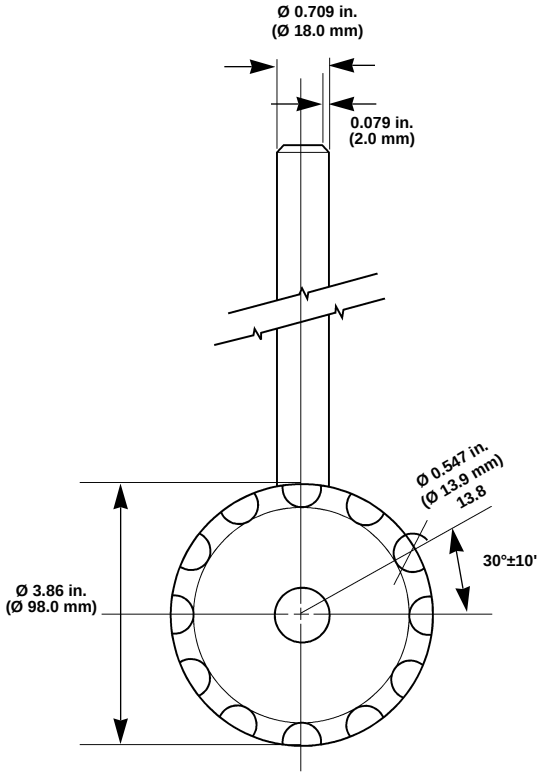
② Tractor oil universal fluid, 'TOU' types formulated for wet disc brakes, is recommended for use in the wet disc brake housing. Make sure that the specifications of the tractor fluid are the same as the recommended specifications of the vehicle manufacturer.

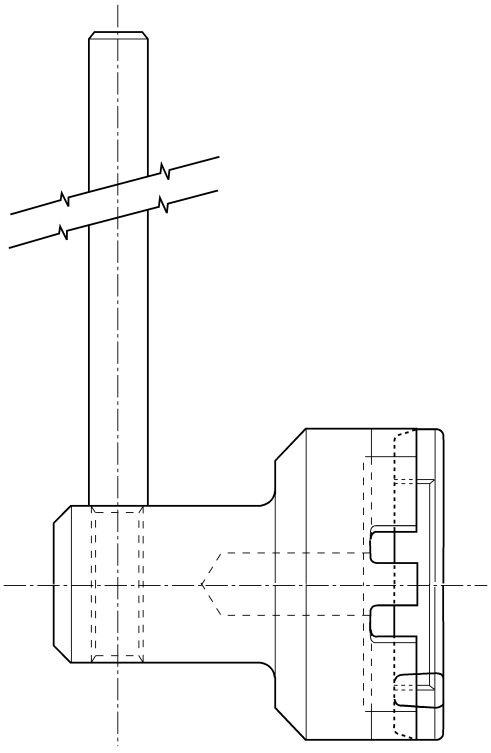
CAUTION

- ***The operating temperature of the coolant must never reach or exceed 250°F (120°C). If the operating temperature of the coolant reaches or exceeds 250°F (120°C), the internal components of the brake will be damaged. A forced cooling system may be required to assure the coolant temperature remains below 250°F (120°C).***
- ***Use only the brake hydraulic fluid specified by the manufacturer of the vehicle. Do not use different hydraulic fluids. The wrong fluid will damage the seals on the piston.***

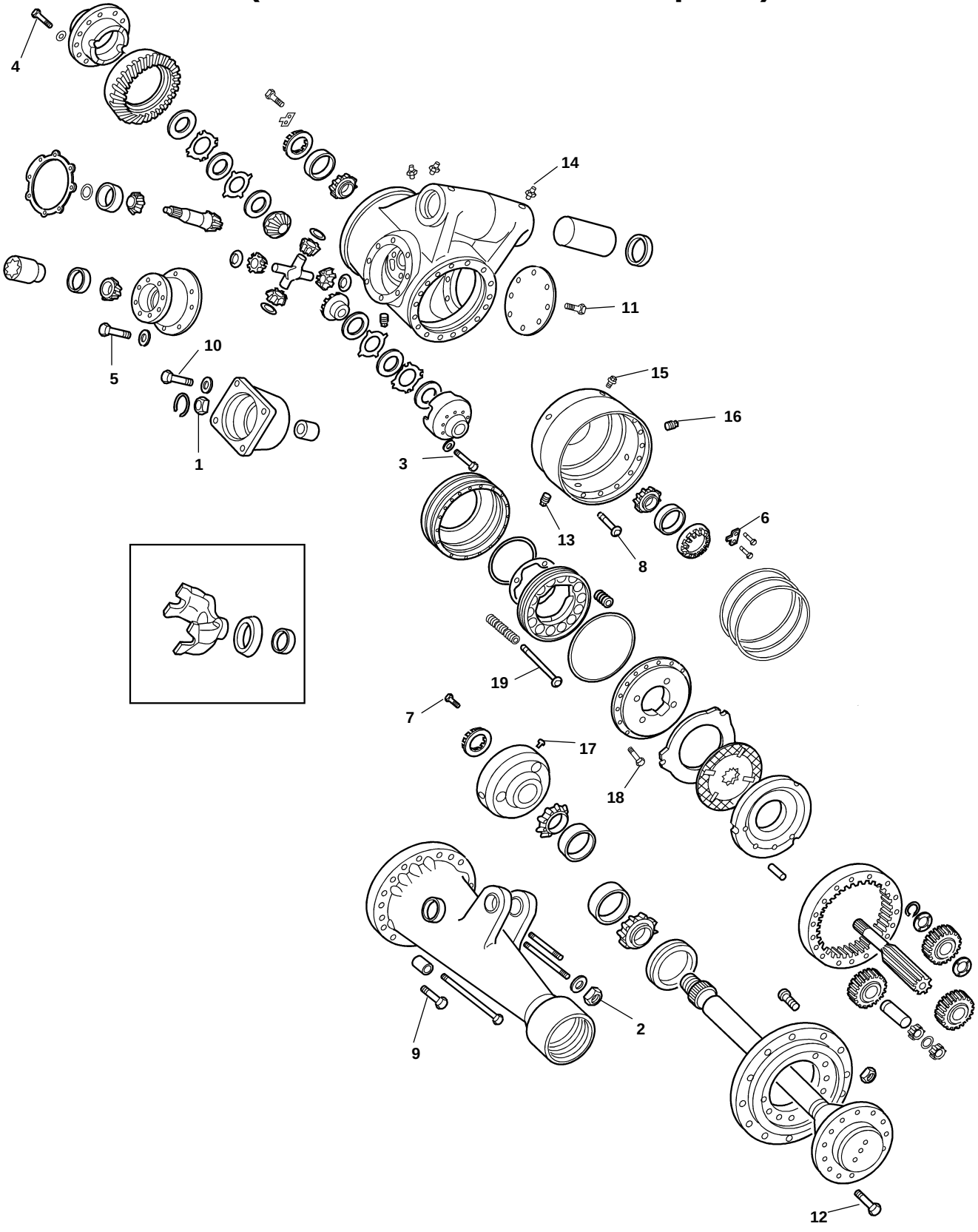
Nut Lock Special Tool







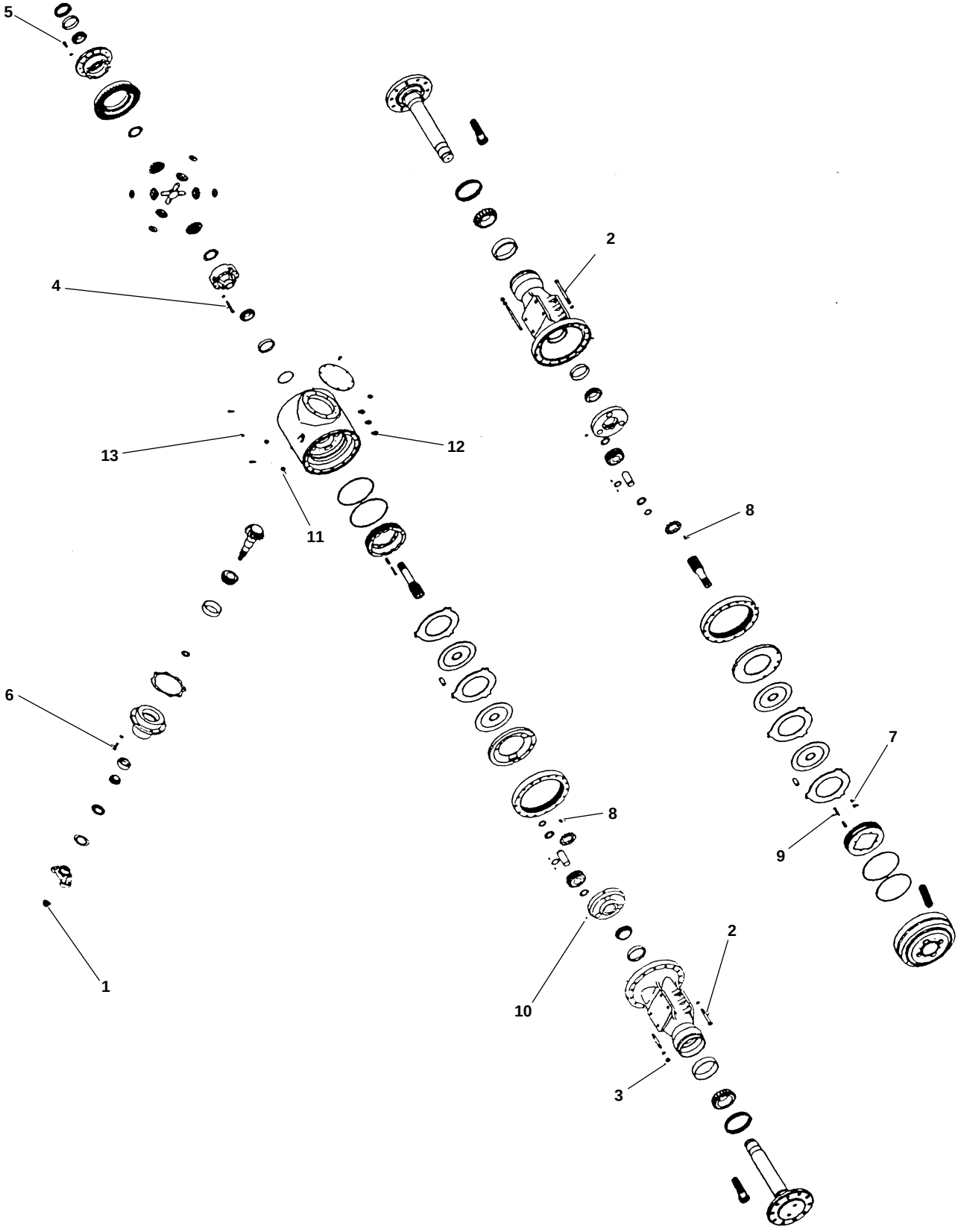
PROA 352/382 (With Mechanical Drive Option)



Torque Chart - PROA 352/382

ITEM	DESCRIPTION/THREAD	TORQUE
1	Pinion Nut - M24 x 1.5-6H	465-570 lb-ft (630-775 N•m)
2	Nut (Stud - Center Housing) M14 x 1.5-6H	120-150 lb-ft (160-205 N•m)
3	Capscrew (Differential Case) M10 x 1.5-8G	48-64 lb-ft (64-87 N•m)
4	Capscrew (Spiral Gear) M10 x 1.0-6G	66-75 lb-ft (90-100 N•m)
5	Capscrew (Pinion Cage) M12 x 1.75-8G	67-91 lb-ft (91-120 N•m)
6	Capscrew (Lock Adjuster Ring) M6 6G	80-115 lb-in (9.0-13.0 N•m)
7	Capscrew (Adjusting Nut Lock) M8 x 1.25-6G	17-23 lb-ft (23-30 N•m)
8	Capscrew (Brake Housing) M8 x 1.25-6G	19-26 lb-ft (26-36 N•m)
9	Capscrew (Brake Releaser) M12 x 1.75-6G	25-34 lb-ft (34-46 N•m)
10	Capscrew (Flange Adapter) .3750” x 16UNC2A	39.0-53.0 lb-ft (53-72 N•m)
11	Capscrew (Center Housing Cover) M8 x 1.25-6G	20-27 lb-ft (27-36 N•m)
12	Capscrew (Axle Shaft Flange) M20 x 1.5-6G	470-575 lb-ft (635-780 N•m)
13	Drain Plug	35 lb-ft (47 N•m)
14	Grease Fitting	31-40 lb-in (3.5-4.5 N•m)
15	Vent Plug	15 lb-ft (20 N•m)
16	Level Plug	35 lb-ft (47 N•m)
17	Capscrew (Planetary Pinion Axle) M10 x 1.5-6G	17-23 lb-ft (23-31 N•m)
18	Bolt (Action Plate) M6 x 1.5-6G	120-140 lb-in (13.5-16.0 N•m)
19	Capscrew (Return Spring) M6 x 1.0-6G	80-115 lb-in (9.0-13.0 N•m)

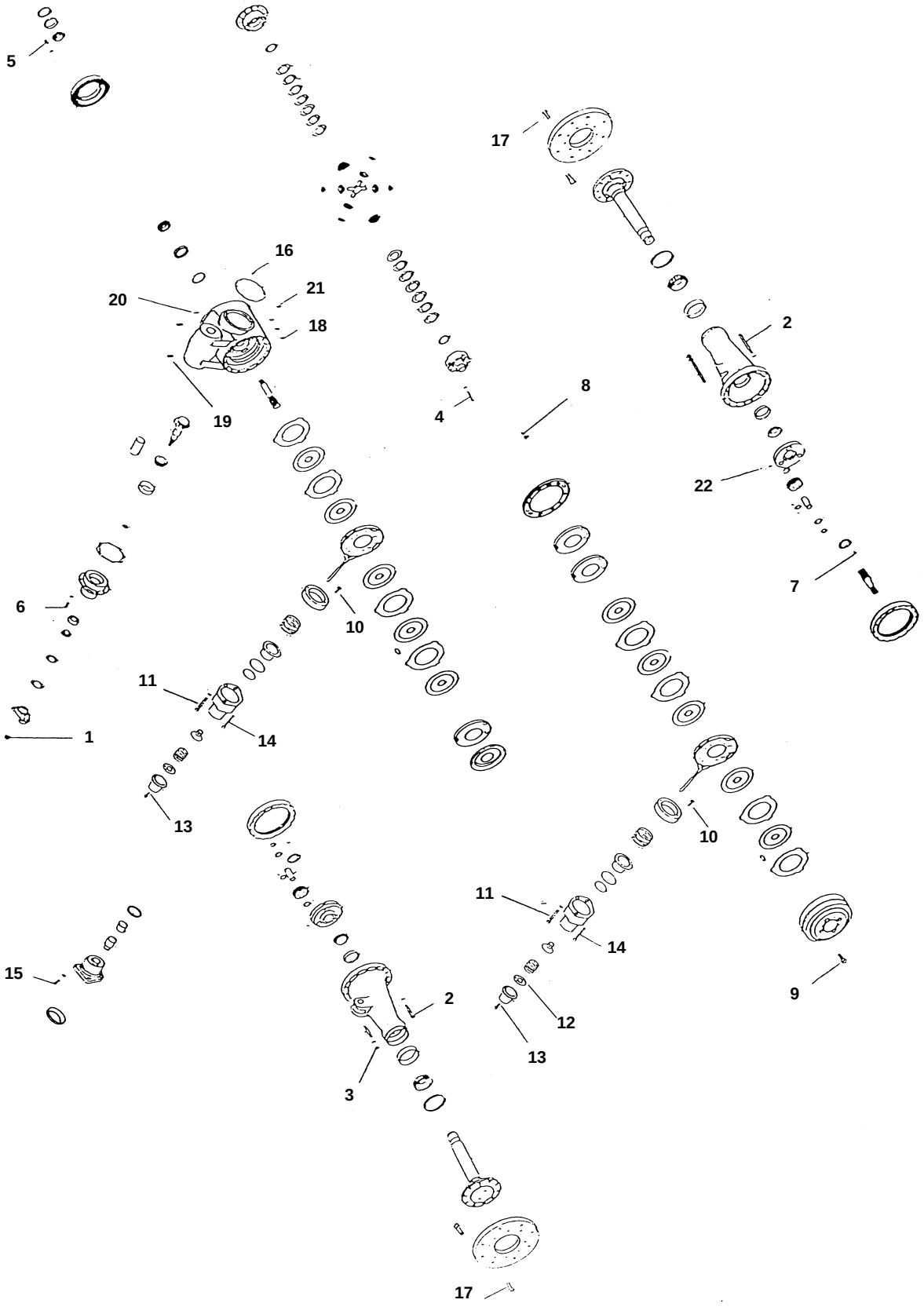
PRA 352 – Trumpet Variation No. 2



Torque Chart - PRA 352

ITEM	DESCRIPTION/THREAD	TORQUE
1	Pinion Nut - M24 x 1.5-6H	465-570 lb-ft (630-775 N•m)
2	Capscrew (Center Housing) - M14 x 1.5-6G	150-185 lb-ft (205-250 N•m)
3	Nut (Stud - Center Housing) - M14 x 1.5-6H	120-150 lb-ft (160-205 N•m)
4	Capscrew (Differential Case) - M10 x 1.5-6G	48-64 lb-ft (64-87 N•m)
5	Capscrew (Spiral Gear) - M10 x 1.0-6G	66-75 lb-ft (90-100 N•m)
6	Capscrew (Pinion Cage) - M12 x 1.75-6G	67-91 lb-ft (90-125 N•m)
7	Capscrew (Lock - Adjuster Ring) - M6-6G	80-115 lb-in (9-13 N•m)
8	Capscrew - Adjusting Nut Lock - M8 x 1.25-6G	17-23 lb-ft (23-31 N•m)
9	Bolt - Return Spring - M6 x 1.0-6G	80-115 lb-in (9.0-13.0 N•m)
10	Capscrew (Planetary Pinion Axle) - M10 x 1.5-6G	17-23 lb-ft (23-31 N•m)
11	Plug - Level - M24 x 1.5	35 lb-ft min. (47 N•m min.)
12	Plug - Drain - M24 x 1.5	35 lb-ft min. (47 N•m min.)
13	Plug - Vent - M12 x 1.5	15 lb-ft min. (20 N•m min.)

PROA 352 G2H, G2M



Torque Chart - PROA 352, G2H, G2M

ITEM	DESCRIPTION/THREAD	TORQUE
1	Pinion Nut - M24 x 1.5-6H	465.0-570 lb-ft (630-775 N•m)
2	Capscrew (Center Housing) M14 x 1.5-6G	180.0-215.0 lb-ft (245-290 N•m)
3	Nut (Stud - Center Housing) M14 x 1.5-6H	120-150 lb-ft (160-205 N•m)
4	Capscrew (Differential Case) M10 x 1.5-6G	48-64 lb-ft (64-87 N•m)
5	Capscrew (Spiral Gear) M10 x 1.0-6G	66-75 lb-ft (90-100 N•m)
6	Capscrew (Pinion Cage) M12 x 1.75-6G	67.0-91.0 lb-ft (91-120 N•m)
7	Capscrew (Lock Adjuster Ring) M6 6G	80.0-115.0 lb-in (9-13 N•m)
8	Capscrew (Adjusting Nut Lock) M8 x 1.25-6G	17-23 lb-ft (23-31 N•m)
9	Capscrew (Brake Housing) M8 x 1.25-6G	19-26 lb-ft (26-36 N•m)
10	Capscrew (Brake Cylinder Support) M8 x 1.25-6G	19-26 lb-ft (26-36 N•m)
11	Capscrew (Brake Cylinder) M10 x 1.5-6G	48-64 lb-ft (64-87 N•m)
12	Cover (Brake Cylinder) M80 x 1.5-6G	60-90 lb-ft (80-120 N•m)
13	Capscrew (Brake Cylinder Cover) M12 x 1.75-6G	22-30 lb-ft (30-41 N•m)
14	Capscrew (Brake Releaser) M12 x 1.75-6G	22-30 lb-ft (30-41 N•m)
15	Capscrew (Flange Adapter) .3750" x 16UNC2A	39.0-53.0 lb-ft (53-72 N•m)
16	Capscrew (Center Housing Cover) M8 x 1.25-6G	19-26 lb-ft (26-36 N•m)
17	Capscrew (Axle Shaft Flange) M20 x 1.5-6G	470-575 lb-ft (635-780 N•m)
18	Drain Plug	35.0 lb-ft (47 N•m)
19	Grease Fitting	10.0 lb-ft (14 N•m)
20	Vent Plug	15.0 lb-ft min. (20 N•m min.)
21	Level Plug	35.0 lb-ft min. (47 N•m min.)
22	Capscrew (Planetary Pinion Axle) M10 x 1.5-6G	17.0-23.0 lb-ft (23-31 N•m)

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PowerWheel® Service Manual
Model 8 Series B
Double Reduction
Wheel Drives

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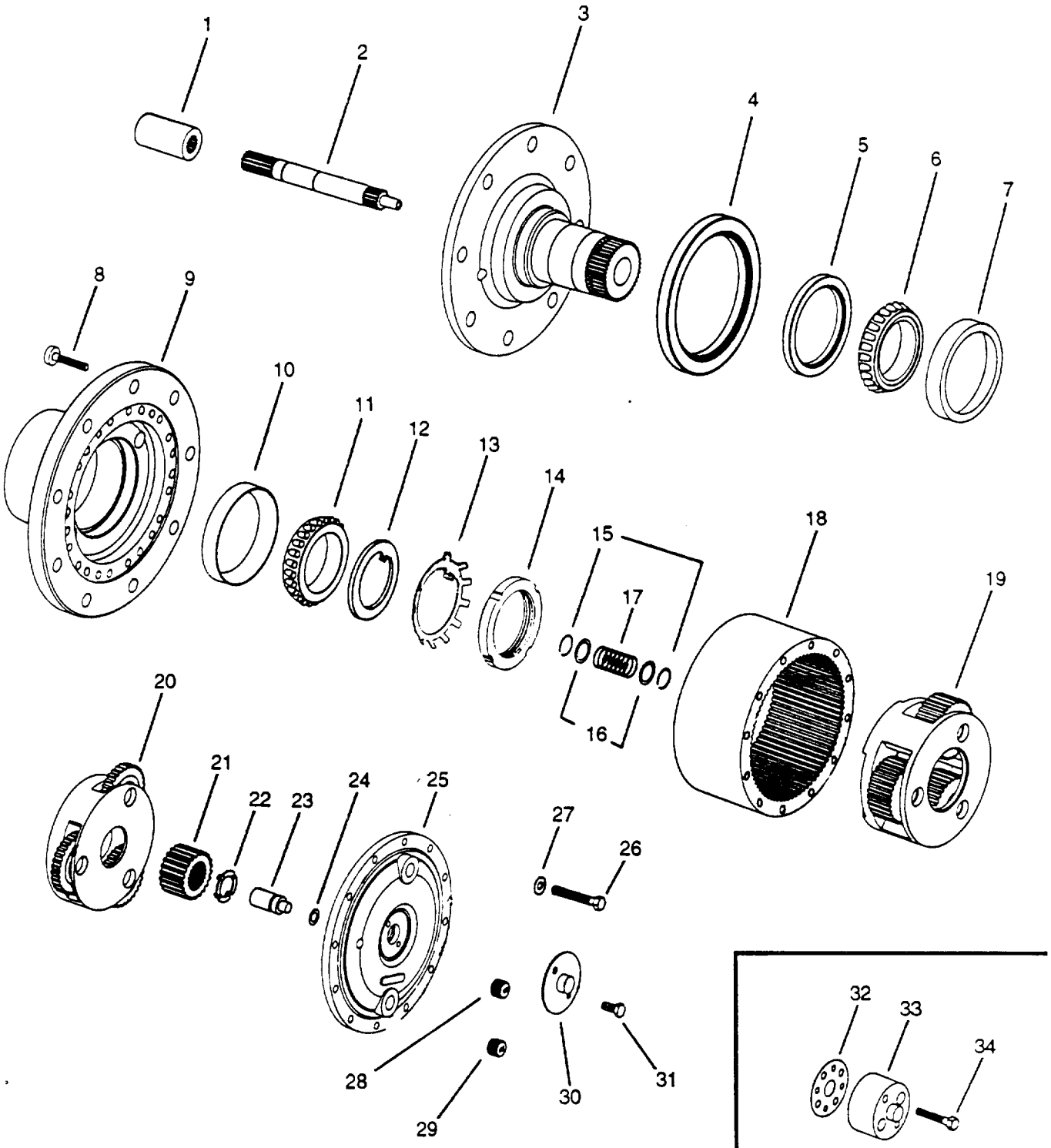
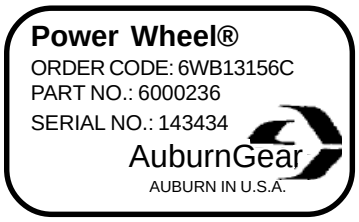


IDENTIFICATION

IMPORTANT: All Power Wheel units and kits are shipped with a name plate that includes the Auburn Gear part number and order code as shown.

Example:



In addition to the nameplate, Power Wheel drives are stamped with an identification number which appears on the cover or hub flange as shown.
Example**: 6000236-A-4-9**
When ordering parts, the information included on the nameplate or the stamped identification number is necessary to accurately identify the drive and obtain
the correct replacement parts. Once this information has been obtained, contact Auburn Gear for appropriate parts list.

DISASSEMBLY OF POWER WHEEL

STEP 1
Slide the coupling (1) from the splines on input shaft (2).
STEP 2
Position the assembly upright on face of spindle (3).
STEP 3
Remove the disengage cover (30) if necessary.
STEP 4
Remove twelve bolts (26) and flat washers (27) and the large cover (25) from the unit. The thrustwasher (22) and the disengage plunger (23) usually remain attached to the large cover (25) when it is removed. Remove thrustwasher (22), disengage plunger (23), and O-ring (24) from the large cover (25).
STEP 5
Remove primary sun gear (21) from end of input shaft (2).
STEP 6
Remove the primary carrier assembly (20).
STEP 7
Remove the secondary carrier assembly (19). It may be necesary to remove the ring gear (18) first, if difficulty is encountered in removing the carrier assembly.
STEP 8
Remove the input shaft (2) from the spindle (3). Remove the retaining rings (15), washers (16), and disengage spring (17) from input shaft (2) only if replacement is requlred.
STEP 9
If not previously removed (see step 7) remove ring gear (18) from hub (9). It may be necessary to strike ring gear (18) with a rubber mallet to loosen from hub (9).
STEP 10
One lockwasher (13) tab will be engaged in the bearing nut (14) slot; bend back to release. Remove the bearing nut (14), lockwasher (13), and thrustwasher (12). **NOTE: A special service tool is required for the removal of the bearing nut. Contact Auburn Gear for procurement of service tool.**
STEP 11
Press spindle (3) from hub (9). NOTE: Bearing cone (11) has been designed with a press fit with respect to spindle (3). Considerable force will be required to remove cone from spindle.
STEP 12
Remove the oil seals (4) and (5) and bearing cones (6) and (11) from hub (9). Inspect bearing cups (7) and (10) in position and remove only if replacement is required.

ASSEMBLY OF POWER WHEEL

STEP 1
Press new bearing cups (7 & 10) in each side of the hub (9). It is recommended that bearing cups (7 & 10) and cones (6 & 11) be replaced in sets.
STEP 2
Assemble bearing cone (6) into cup (7) at seal end of hub (9) and press a new seal (5) into hub (9). Install boot seal (4) on hub (9) if unit is so equipped.
STEP 3
Position spindle (3) upright on bench. Lubricate lips of seals (4) and (5) and lower hub (9) onto spindle (3). Hub (9) shouid be centered as it is lowered over spindle (3) to prevent seal damage.
STEP 4
Assemble bearing cone (11) over spindle end. Press bearing cone (11) over spindle bearing journal using press and cylindrical bearing tool AG08404B. Press bearing cone (11) down until roller just touches cup (10). (OPTIONAL: Use hammer and bearing tool AG08404B to install cup (11) over spindle (3). Take care when using this method to avoid pressing cone (11) too far. As in other method, rollers should just touch cup (10)).
STEP 5
Install thrust washer (12) and bearing nut (14). DO NOT install lockwasher (13) at this time.
STEP 6
Place rolling torque tool AG08771C over spindle (3) and bolt or pin to hub (9).STEP 7
Check initial rolling torque by installing an inch-lb. torque wrench on center nut of rolling torque tool and turning hub (9) slowly and steadily with the torque wrench. Note mean torque. An initial bearing rolling torque of greater than 52 in-lbs. means that the cone (11) was pressed on too tightly in step 4. In this case, back off bearing cone (11) by pressing spindle (3) out of cone (11) until initial preload is relieved.
STEP 8
Torque bearing nut (14) with bearing nut wrench AG07366B until a bearing rolling torque of 44-52 in-lbs., with a boot seal installed, or 4048 in-lbs., without a boot seal, is reached. This may require several trials of pressing the cone (11) by torqueing the nut (14) and then checking the rolling torque. Rotate hub (9) by hand as nut is being tightened in order to seat bearings. NOTE: Up to 250 ft-lbs. of torque may have to be applied to bearing nut (14) in order to press cone (11) into position.
STEP 9
Remove bearing nut (14) and install lockwasher (13). Install nut (14).
STEP 10
Re-torque bearing nut (14) to 65-75 ft-lbs.
STEP 11
Secure bearing nut (14) by bending a lockwasher (13) tab into one of four bearing nut slots. If no tab aligns with a slot, the nut may be tightened until one of the slots aligns with a lock washer tab.
STEP 12
Assemble a washer (16), spring (17), a second washer (16), and a retaining ring (15) in the middle grooves of input shaft (2). Install a second retaining ring (15) in groove near small end of input shaft (2).
STEP 13
Assemble the splined end of the input shaft (2) down into spindle (3).
STEP 14
Assemble the secondary carrier assembly (19) to spindle (3) at splines.
STEP 15
Clean mating surfaces and apply a bead of silicone sealant to face of hub (9) that mates with ring gear (18). (See instructions on sealant package). Assemble ring gear (18) to hub (9) being careful to align bolt holes.
STEP 16
Assemble the primary carrier assembly (20) into the ring gear (18). It will be necessary to rotate carrier to align secondary sun gear (part of primary carrier assembly (20)) with planet gear teeth in secondary carrier assembly (19). Assemble primary sun gear (21) over input shaft (2). Rotate primary sun gear (21) to align input shaft (2) to gear splines and gear teeth in primary carrier assembly (20).
STEP 17
Lubricate O-ring (24) and assemble in groove inside cover hole, push disengage plunger (23) into cover (25) with pointed end facing inside of unit.

STEP 18
Assemble the thrust washer (22) with tangs engaged with cover (25). NOTE: A small amount of grease applied to the back side of thrust washer (22) will hold washer in place. Apply a bead of silicone sealant to end face of ring gear (18) Assemble cover (25) aligning holes of cover and ring gear. Assemble the twelve 3/8-16 x 6-1/2 inch grade 8 bolts (26) and flat washers (27). Torque bolts to 45-50 ft-lbs.

STEP 19
Assemble the disengage cover (30) with dimpled center protruding out if wheel is to be used to drive the vehicle. Assemble and torque the two 5/16-18 x 1/2 inch bolts (31). Torque bolts to 10-20 ft-lbs.

STEP 20
Invert the Power Wheel assembly and assemble the coupling (1), with counterbore out, to the input shaft (2).

NOTE: When installing a hydraulic motor to the Power Wheel drive it is necessary to place an O-ring or gasket (not supplied by Auburn Gear) between the motor and planetary drive. O-ring sizes--SAE A: 2-042, SAE B: 2-155, SAE C: 2-159.

CARRIER ASSEMBLIES

It is recommended that the primary and secondary carrier assemblies (19 & 20) be serviced in their entirety to protect the integrity of the Power Wheel drive.

LUBRICATION RECOMMENDATIONS

IMPORTANT: POWER WHEEL PLANETARY DRIVES ARE SHIPPED WITHOUT LUBRICANT AND MUST BE FILLED TO THE PROPER LEVEL PRIOR TO START UP.

Observe lubrication recommendations given by the original equipment manufacturer. When specific recommendations are not available, use mild extreme pressure lubricant API-GL 5, No. 80 or 90 when filling the Power Wheel under normal temperature ranges between 0-120 F (-18 to 49 C). Power Wheel is to be half full of oil when unit is mounted level and horizontal. Use drain and fill plug located in cover. Oil to be changed after first 50 hours of operation with subsequent changes every 1000 hours or yearly, which ever comes first. If unit is to be operated vertically. if ambient conditions are outside the specified range, or if the oil temperature exceeds 200 F (93 C) contact Auburn Gear for oil and level recommendations.

TOWING VEHICLE

CAUTION: The Power Wheel will not normally be damaged by towing; however, the hydraulic drive components may be damaged unless the Power Wheel is disengaged from the drive motor. Road speeds in excess of 25 MPH should be avoided unless clearly specified to be permissible by the equipment manufacturer.

TO DISENGAGE POWER WHEEL

CAUTION: For units equipped with the standard spring disconnect, assemble the disengage cover (30) with the dimpled center protruding inward. For units equipped with the optional quick disconnect, push in center plunger of disconnect.

STORAGE

A protective film is applied to the Power Wheel at the factory to prevent rust during shipment. Additional protection may be required if the Power Wheel is to be stored for an extended period of time.

SEALING COMPOUND

Silastic RTV 732 sealer and General Electric Silimate RTV No. 1473 or RTV No. 1503 are currently recommended for sealing gasket surfaces. Sealant should be applied in a continuous bead, which should be centered on the surface to be sealed but should move to the inside of the hole at each bolt hole location. For service requirements order Auburn Gear Part number 604101.

SPECIFICATIONS

Maximum intermittent output torque .....100.000 lb in (11.300 Nm)
Maximum input speed..... 5.000 RPM
Oil capacity .....57 oz (1685 ml)

ITEM NO.	DESCRIPTION *	NO. USED IN ASS'Y.	ITEM NO.	DESCRIPTION *	NO. USED IN ASS'Y.
1	Coupling	1	18	Ring Gear	1
2	Input Shaft	1	19	Secondary Carrier Assembly	1
3	Spindle	1	20	Primary Carrier Assembly	1
4	Boot Seal 604403	1	21	Primary Sun Gear	1
5	Oil Seal 604409	1	22	Thrust Washer	1
6	Bearing Cone 14-00-133-007	1	23	Disengage Plunger	1
7	Bearing Cup 14-00-133-006	1	24	"O" Ring 614101	1
8	Wheel Bolt	8-10	25	Large Cover	1
9	Hub	1	26	Hex Head Bolt (Grade 8)	12
10	Bearing Cup 613314	1	27	Flat Washer	12
11	Bearing Cone 613315	1	28	Magnetic Plug 14-00-052-002	1
12	Thrust Washer	1	29	Pipe Plug	1
13	Lock Washer	1	30	Disengage Cover 14-02-039-005	1
14	Bearing Nut	1	31	Hex Head Bolt	2
15	Retaining Ring	2	32	Quick Disconnect Gasket	1
16	Washer	2	33	Quick Disconnect Assembly	1
17	Disengage Spring	1	34	Hex Head Bolt	2

* Contact Auburn with part number and order code of drive to obtain the apropriate parts list. Refer to parts list for the specific part numbers and quantities.

Model 8 Series B Power Wheel® Service Kits

Part No.	Description	Included Items
593 RR Shown	Model 8 Series B Bearing Locknut Tool Not	Not Shown

 Power Wheel is a registered trademark of Auburn Gear

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GRADALL®

material handlers

532/534 Boom Maintenance

Form No. 29906

Issued 11/99

REVISIONS

- This page is provided so you may determine that this Manual is complete and current with respect to Gradall Engineering Specifications.

Page	Date	Revision

532/534 Boom Maintenance
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Covers Material Handlers:
532C-6/534C-6 Starting Serial No. 0188002 Through 0488378
534C-9 Starting Serial No. 0344004 Through 0444189
534C-10 Starting Serial No. 0266001 Through 0266139
534D-6 Starting Serial No. 0588001
534D-9 Starting Serial No. 0544001
534D-10 Starting Serial No. 0366001

Read and understand this Manual along with the appropriate *Owner/Operator Manual*, the *Gradall Material Handler Safety Manual*, the *EMI Rough Terrain Forklift Safety Manual* and all instructional decals and plates before starting, operating or performing mechanical adjustments and maintenance procedures on this equipment. Keep Operator and Safety Manuals in the operator's cab.

Orientation

When used to describe the location of components on the machine, the directions "front","rear","left", and "right" indicate the point of view of a person sitting in the operator's seat in the cab.

Fastener and Fitting Torque

Torque values for mechanical fasteners and hydraulic fittings are given in "Appendix A" and "Appendix B". They must be adhered to at all times. **LOCTITE 242** (P/N 1440-3364) must be used on all bolt threads. **LOCTITE 545** (P/N 1440-4043) must be used on all hydraulic fittings. Whenever a hydraulic hose is tightened, two wrenches must be used; one to tighten the hose, the other to hold it from twisting. Hoses must lie and roll free of twist.

Preparing The Material Handler For Service

1. Before performing any maintenance or service, position the material handler in a safe, open, level area, well away from traffic lanes, buildings, other equipment or personnel.
2. Set the park brake and shift the transmission to "Neutral."
3. Lower the forks to the ground.
4. Place the controls in "Neutral," idle the engine 3 minutes for gradual cooling then shut the engine off.
5. Cycle the hydraulic controls, remove the ignition key and fasten a "Do Not Operate" tag to the steering wheel.
6. Dismount from the material handler facing the machine using the proper hand rails, grab irons and/or ladders provided. Always maintain 3-point contact with the handler while dismounting or mounting.
7. If you must park on a slope or incline, position the material handler at right angles to the slope and chock the wheels.

DANGER

Since you will occasionally have to perform service/maintenance procedures with the material handler running, you must take extra precautions to avoid being injured, perhaps fatally. At a minimum this means:

- Set the park brake.
- Chock the wheels.
- Avoid all exposed moving parts.
- Post a warning in the operator's cab that you are working on the machine.
- Work with an assistant.
- Maintain vision to assistant allowing you to know where he is and what he is doing.

Additional Maintenance/Service Precautions

- Refer to the safety decals on the machine and in the relevant *Owner/Operator Manual* before attempting any repair or adjustment.
- If you are working with someone else, make sure they understand the procedure. Make sure each of you knows what to expect and when to expect it. Make sure each of you knows where the other is at all times.
- Make sure you wear all the protective clothing and personal safety gear necessary to perform the service safely.
- Make sure there is adequate light and ventilation in the work area.
- Remove oil, grease, mud, snow, water or any other substance that might cause slippery surfaces from all climbing, walking and working areas.

Note!

Steps 4 and 5 clearly relate to maintenance and service procedures performed with the machine shut down. Although ideal, this may not be possible. Some procedures can only be performed with the machine running. Therefore, this list of precautions headed "Preparing the Material Handler for Service" should be modified according to the specific circumstances of a particular service/maintenance procedure.

- Clean around the area to be serviced to minimize any possibility of contamination.
- Use only the correct tools to perform any check, service or repair.
- Make sure any lifting and supporting devices you use are stable and strong enough to handle the weight of the material handler or component.
- Remove only the guards/covers on the area being serviced. Replace all guards/covers immediately upon completion of the task.
- If the material handler has special optional equipment, make sure that the appropriate maintenance and operational requirements are understood by everyone who operates and services the machine.

What This Manual Covers

This Manual covers maintenance and repair procedures for the three-section boom assembly of all 532 and 534 Series Gradall Material Handlers. Specifically this includes; 532C-6, 534C-6/T, 534C-9/C-10, 534D-6/T & 534D-9/D-10. Mechanical adjustments, replacement, removal and reinstallation of major components are covered. Hydraulic system operations are not discussed. Refer to appropriate manuals for this information. Areas requiring special attention are so indicated.

Illustrations and pictures used are taken from various models. They are typical with regards to assembly and component location and should be used for reference only.

Information in the various charts, tables and illustrations is correct at the time of printing. Refer to the appropriate current *Gradall Parts Manual* to verify correct component Part Numbers.

Special Note on Boom Cables

The extension/retraction boom cables used on all Gradall 532 and 534 Series Material Handlers are made of wire rope. All wire ropes in service should be inspected regularly for damage and evidence of wear. Refer to the *Wire Rope Users' Manual* and *OSHA Wire Rope Excerpts*, both published by the American Iron and Steel Institute Committee of Wire Rope Producers.

Users of Gradall Material Handlers equipped with wire rope should conduct a thorough inspection of all wire rope boom cables at least once a month, keeping full and accurate records as to the condition of the ropes. Any deterioration will lead to the depletion of original rope strength which is sufficient cause to replace the rope.

Listed below are some conditions that warrant wire rope replacement:

- Corrosion of wire rope.
- More than one broken wire in any one strand. Breaks in valleys between strands indicate problems (fatigue, breakage) in wires not necessarily visible on the surface.
- More than one broken wire near attached fittings.
- Heavy wear and/or broken wires in rope sections under sheaves where rope travel is limited.
- Evidence of reduction in original rope diameter, allowing for normal stretch factors.
- Excessive abrasion, scrubbing and cleaning of outside wires.
- Pitting, kink damage or evidence of other kinds of mechanical trauma.

In addition to inspecting wire rope boom cables regularly, inspect all sheaves, guards, guides and other surfaces which are in contact with the rope during boom operation. Any defect/damage to the above listed components poses a risk to the integrity of the rope.

DO NOT reach into the Boom until you are CERTAIN the keys have been removed from the ignition.

A fully comprehensive set of inspection procedures and guidelines (including replacement recommendations) is practically unattainable because of the many variables involved. In the final analysis, SAFETY depends largely on the good judgment of competent service personnel in determining:

(i) Damage to wire ropes
(ii) The remaining service life expectancy of the wire rope. If there is **any doubt**, the rope **must** be replaced
(iii) The proper procedures to replace worn or damaged rope

If you have any questions, including inquiries about the American Iron and Steel Institute publications mentioned above, please call your Authorized Gradall Distributor or Gradall Product Support at (330) 339-2211.

THE FOLLOWING SYMBOLS CALL YOUR ATTENTION TO IMPORTANT SAFETY NOTICES:

DANGER	This symbol indicates an extreme hazard which would result in high probability of death or serious injury if proper precautions are not taken.
WARNING	This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.
CAUTION	This symbol indicates a hazard which could result in injury or damage to equipment or property if proper precautions are not taken.

DANGER, WARNING and CAUTION notes in this Manual will help you avoid injury and damage to the equipment.

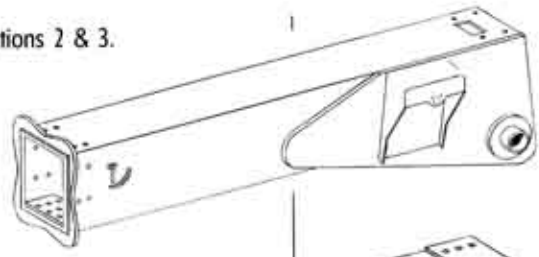
Any procedure not specifically recommended by Gradall must be thoroughly evaluated from the standpoint of SAFETY before it is placed in practice. If you are not sure, contact your Authorized Gradall Distributor.

Do not modify this machine without written permission from Gradall.

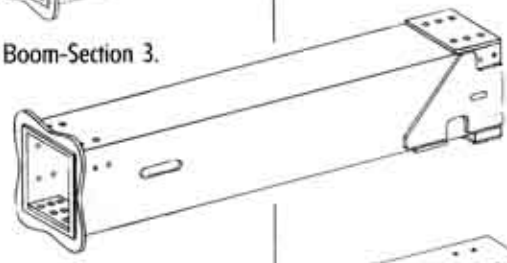
Note on Using the Manual

This Manual contains a series of maintenance and repair procedures for the Boom Assembly of all 532 and 534 Series Material Handlers. In every instance—unless otherwise noted—there are certain basic precautions and steps you should take before working on the machine. These precautions are outlined in the "Introduction" under the heading "Preparing the Material Handler for Service." You must read, understand and comply with these instructions in every instance before working on the machine. You must also observe the general warnings listed under the heading, "Additional Maintenance/Service Precautions," also in the "Introduction."

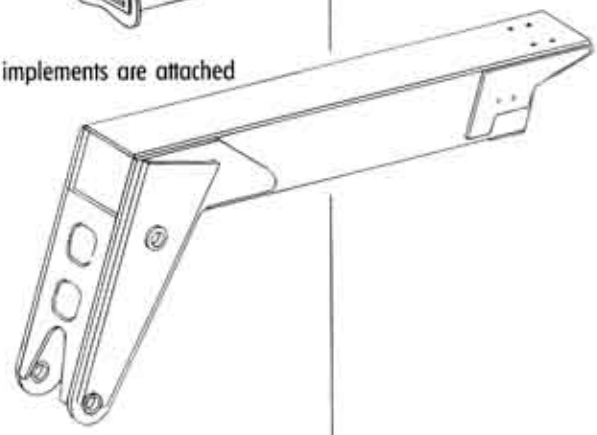
BOOM-SECTION 1
Base boom connected to the carrier frame that houses Boom-Sections 2 & 3.



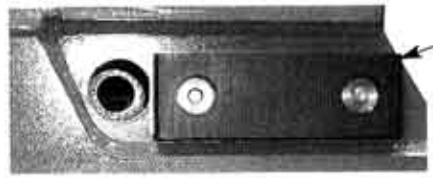
BOOM-SECTION 2
Intermediate Boom-Section, located inside Boom-Section 1, houses Boom-Section 3.



BOOM-SECTION 3
Outer Boom-Section located inside Boom-Section 2. Working implements are attached to the boom head end of this section.



BEARING PAD
Also known as a "Slider Pad" or a "Wear Pad". Mounts to the boom and contacts mating boom surface. Reduces friction during boom extension and retraction. Keeps Boom-Sections centered with each other.

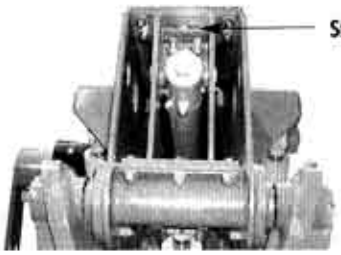


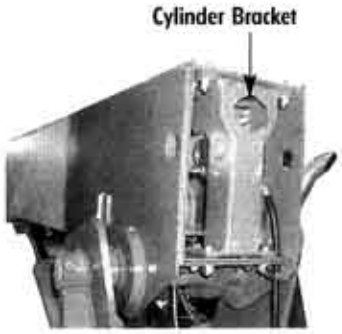
BEARING PAD SPACER
Mounts on the inside of a bearing pad, facing the boom surface. Provides a solid surface for boom bearing pad shims. Gradall Part Number and thickness is stamped on each spacer.

SHIM
Metal plate used to fill the space between components, allowing the component to be properly placed against a solid surface, (bearing pad, strongback, etc). Gradall Part Number and thickness are stamped on each shim.

Push Beam (534C-9/C-10 & D-9/D-10 only)
Weldment that houses the crowd cylinder and the extension cable sheave assembly. Mounts to the rear of Boom-Section 2.

Strongback
Also known as the Cylinder Bracket on the 532C-6, 534C-6 & 534D-6. Located at the inside rear of Boom-Section 1. Extension cables and the base end of the crowd cylinder are mounted to this weldment.





Crowd Cylinder
Extends and retracts the complete Boom Assembly.
534C-9/C-10: Located inside the push beam. Rod eye pinned to the push beam; base end pinned to the strongback.
532C-6, 534C-6 & 534D-6: Rod eye pinned to the cylinder bracket and barrel-mounted to the rear of Boom-Section 2.

Tilt Cylinder
Tilts the boom attachments forward or backward. Located in the boom head of Boom-Section 3.

Boom Cable
Wire Rope that mechanically extends and retracts Boom-Section 3.

Boom Cable Sheave
Grooved rollers that the boom cables ride on. As the sheave rotates, the cable is extended or retracted from its anchor point. There are extension and retraction sheaves used in the boom assembly. They are located at the front end of the push beam and the rear of Boom-Section 2.

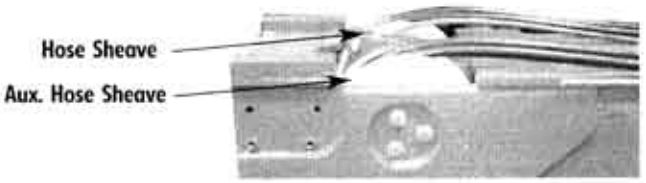
534D-6 Extend Cable Sheave
Front View

Hydraulic Hoses

Located inside boom assemblies. Used to carry fluid to the attachment; fastened to the end of Boom-Section 3.

Hose Sheave

Located at the inside left of Boom-Section 2. The plastic roller is designed with lips on the outer edge of the OD. As the booms extend and retract, the roller rotates against the hoses, maintaining the proper radius point of the hose. The lips keep the hose captive on the roller.

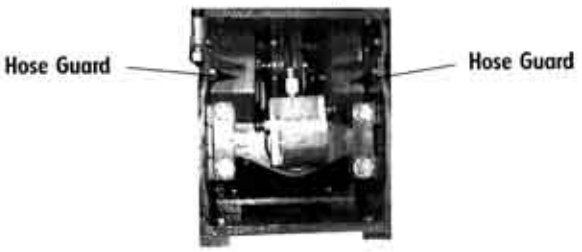


Note!

Boom-Section inverted 180° (upside-down)

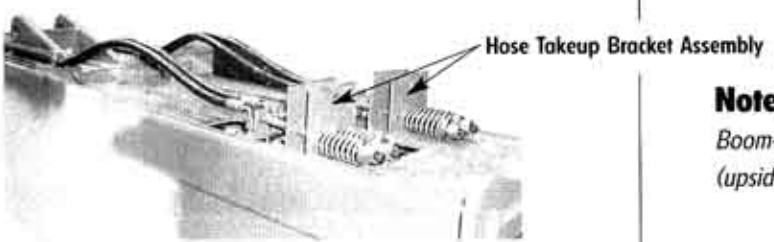
Hose Guard Plate

Located in the back of the hose sheave, the hose guard plate protects the hoses from contamination and prevents them from jumping the lips of the hose sheave.



Hose Take-Up Assembly

Located at the outside bottom of Boom-Section 1, the Hose Take-Up Assembly weldment absorbs sudden shocks which impact the tilt circuit and auxiliary circuit hydraulic hoses, minimizing the possibility of hose failure.

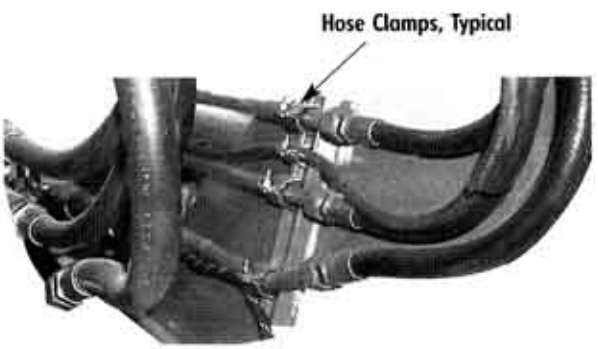


Note!

Boom-Section Inverted 180° (upside-down)

Hose Clamp Sets

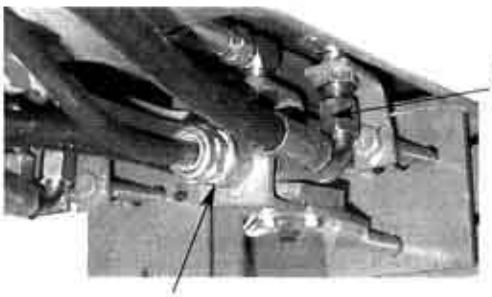
Keep hydraulic hoses located in a fixed position. Hose movement and damage is minimized when hoses are properly clamped.



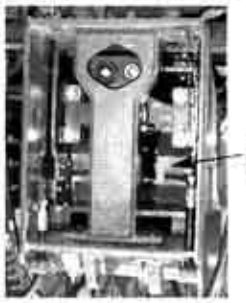
Auxiliary Circuits

Special attachments may require additional hydraulic and electric circuits. These circuits are fed to the attachments through the right side of the boom assembly. They are similar to the standard circuits in the left side of the boom.

Front Bottom, Boom-Section 1:
Cable Take-Up Bracket



Rear View Boom Assembly



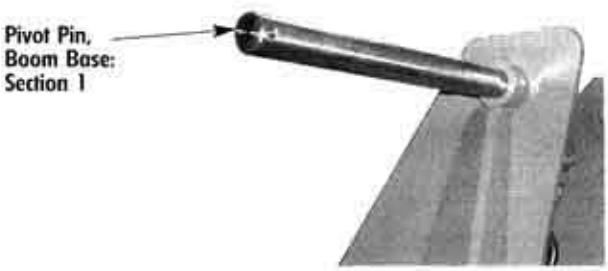
Fasteners

Refer to Appendix "A" at the rear of this Manual for correct torque values.
***LOCTITE* 242** (P/N 1440-3364) must be used on all fasteners when setting the torque.

Bearing Pad Mounting Bolt
and Washer

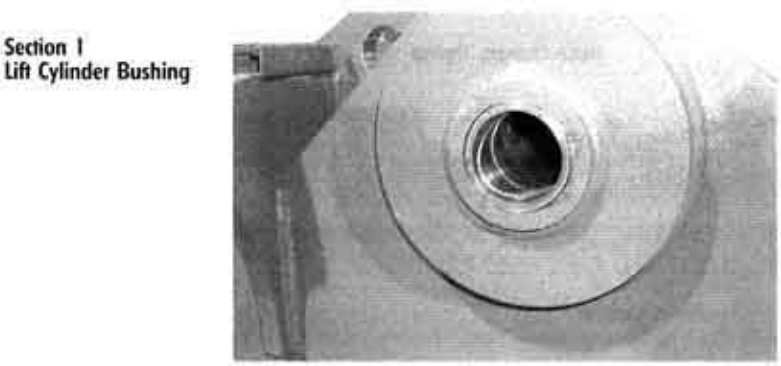
Pins

Special dimensioned pins are used in some locations to fasten components together. During installation and removal, care must be taken to protect the outside surface and any lubrication passages.



Bushings

Bushings equipped with lubrication grooves are used in conjunction with pins. Lubricate ID and OD of bushings before installation in parent bore and pin installation.



Optimum Boom Assembly Performance and Service Life depend on proper adjustment and alignment of components. A boom is considered in proper adjustment as long as the following criteria are met:

- Boom-Sections centered to each other.
- Extension/Retraction cables are adjusted properly, resulting in simultaneous extension and retraction of Boom-Section 3, proportional to the crowd cylinder, throughout partial and/or full boom travel.
- Hydraulic circuit hoses (including Auxiliary Hydraulic and Electric) are properly installed, resulting in stress-free movement during boom extension/retraction cycle.

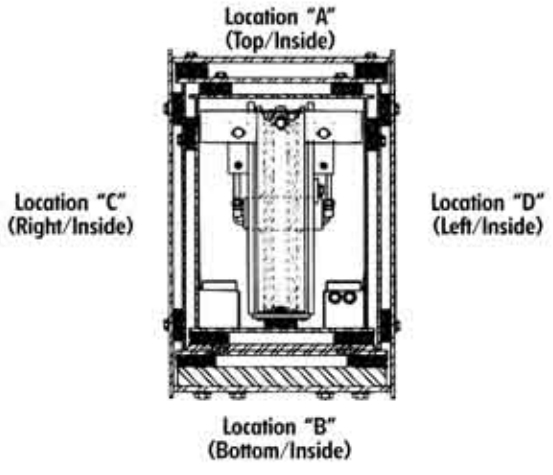
BOOM ADJUSTMENT PROCEDURE:

CENTERING OF BOOM-SECTIONS TO EACH OTHER

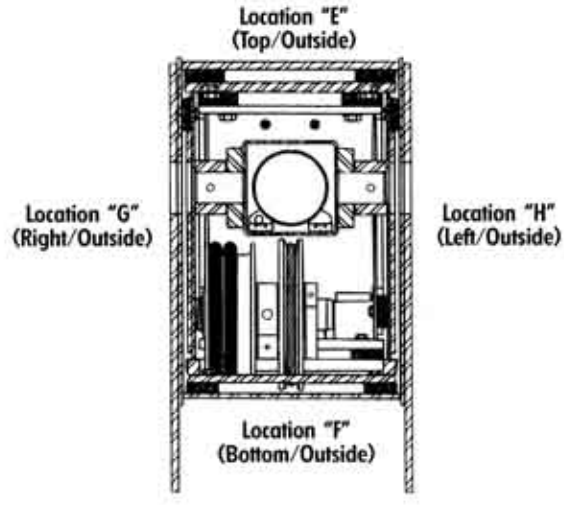
BEARING PAD PACKAGE

Boom bearing pads (sometimes called slider pads or wear pads), spacers and shims are used as a package to achieve proper centering of Boom-Sections to each other. For the purpose of clarification, the area and location of bearing pad packages are referenced below.

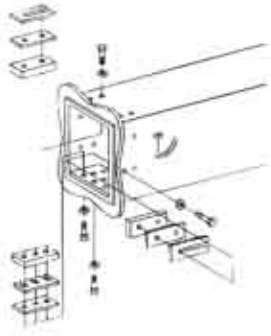
END VIEW AREA 1 & 2



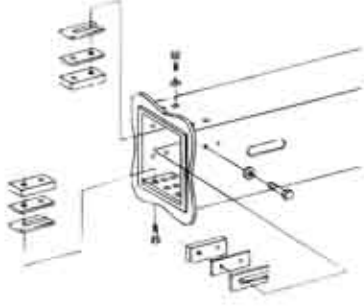
END VIEW AREA 3 & 4



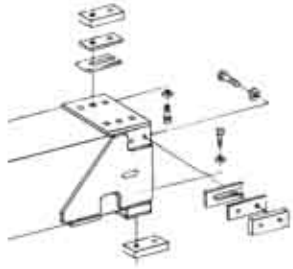
BOOM-SECTION 1:
AREA 1, FRONT INSIDE



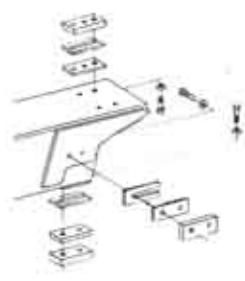
BOOM-SECTION 2:
AREA 2, FRONT INSIDE



BOOM-SECTION 2:
AREA 3, REAR OUTSIDE



BOOM-SECTION 3:
AREA 4, REAR OUTSIDE



Note

The 534C9/10 and 534D9/10 booms require 3 bolts on the bottom front bearing pads on section one. They also require 3 bolts on the boom bearing pads on the bottom front and top rear of section two and the top rear of section three. All other boom bearing pads as well as all the boom bearing pads on the 532/534C6 and 534D6 require two bolts.

Boom Wear Pad Adjustments

To maximize boom service life, wear pads must be carefully adjusted at all times. The following Service Notes are a general guide for properly adjusting boom wear pads:

General Service Notes

- Familiarize yourself with all bearing pad package components.
- Add bearing pad spacers (backing plates) and shims as required to fit boom within 1/16" of tight fit to mating outer boom.
- Boom-Sections 2 and 3 should be evenly centered to outer Boom-Section 1. Spacer and shim packs should be equal (within 1 shim) side to side and top to bottom.
- It may be possible on new booms for bearing pads only to be installed. There may not be room for spacers and shims.
- Insert spacers between pad and shim.
- Be sure no pad sits directly on the slotted surface of a shim.
- Bolts must not extend beyond the chamfer on the bearing pad. The length of pad bolts depends on the number of shims used.
- If no shim is used with the bearing pad, two washers are installed under the head of the bolt against the boom. Remove one washer if a shim is installed at a later date, otherwise the bearing pad will not be securely held in place by the bolt.
- Grease bearing pads and pad slide area on the boom with *Mystik Tetrimoly* grease (or equivalent) (Gradall P/N 1440-4595).
- Apply **LOCTITE 242** (Gradall P/N 1440-3364) to all bolt threads.
- Bearing pad bolt torques are:
  3/8" bolt: 32-37 ft-lb
  1/2" bolt: 76-86 ft-lb
- Do not overtorque pad mounting bolts. Overtorqueing will pull the pad nut through the pad. The pad will then fall out of the boom.
- Booms should not be adjusted so tight that the lube is wiped off the sliding path.
- Visual checking of the witness lines left on the bearing slide path may assist in determining which side of the boom is not making proper contact with the bearing pad.
- If a wedge is used to assist in shifting a Boom-Section for adjustment, be certain it is removed before activating the boom circuit. Damage to the boom structure will occur if the boom is retracted with a wedge left installed. Do not use more than one wedge at a time during the adjustment operation.
- You can use .060" thick shim stock as a feeler gauge to check boom clearance to bearing pad.
- Shims and spacers are stamped with their part number and thickness for quick reference. Check the ones you are installing against the ones installed in the same area. Make sure you install the right ones.

Boom Adjustment Procedure:
Area 1 and Area 2 (Pad location "A" & "B")

→ Inspection

1. Extend the boom three-quarters of total travel. (Extend at least 1 ft. beyond access holes.)
2. Lower the boom using slight down-pressure to remove Boom-Section weight from the bottom.
3. Using a feeler gauge, measure the gap between the bearing pad and the boom at Area "2", location "B".

.060" Shim (used as feeler gauge)

4. If the gap is more than $^{1}/_{16}$", shims must be added to bring the boom into tolerance.

Note!

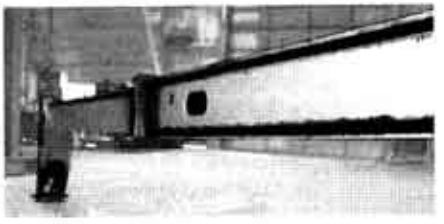
Shim packs should be equal top to bottom (within 1 shim), location "A" and "B". If an unequal amount of shim must be added, first add the shims to location "A" then equalize the shim pack at the next adjustment. Do not use more than 3 levels of shims. The bottom of the boom, Location "B", is most critical. Shim pack levels must ***always*** *be equal (within 1 shim) at this location.*

→ Adjustment

1. Loosen the bearing pad mounting bolts at locations "A" or "B" (or both) and add required shims.
2. Shims are stamped with the Gradall Part Number and thickness. Check the part number on the shim in the area you are installing additional ones and make sure they are the same.
3. Apply ***LOCTITE* 242** to the threads on the pad mounting bolts.
4. Re-torque the bearing pad mounting bolts.
5. Repeat "Inspection" Steps 3 & 4 and "Adjustment" Steps 1 & 2 for Area 1, Location "B".

Area 1 & 2

Extend the Boom, Slight Down-Pressure



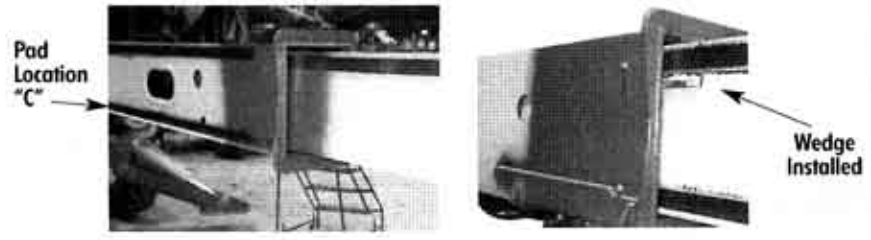
Area 1, Location B

ADJUSTMENT PROCEDURE:

AREA 1 AND AREA 2 (PAD LOCATION "C" & "D")

→ **Inspection**

1. Extend the boom three-quarters of total travel. (Extend at least 1 ft. beyond access holes)
2. Lower the boom to 1ft. of ground clearance.
3. Install a wedge between Boom-Section 2 and 3 at Area 2, Location "C".



4. Hammer a wedge into the area between Boom-Section 3 and 2 at Location "C", forcing it against the opposite side (Location "D").

CAUTION **Do not distort the side plates of the boom sections.**

5. Using a feeler gauge, measure the gap between the bearing pad and the boom at Area 2, Location "C".
6. If the gap is more than 1/16", shims must be added to bring the boom into tolerance.

Note!

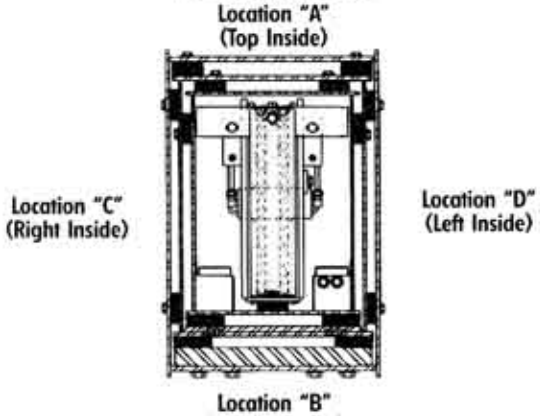
Shim packs should be equal side to side (within 1 shim), Location "C" & "D". If an unequal amount of shim must be added, equalize the shim pack at the next adjustment.

→ **Adjustment**

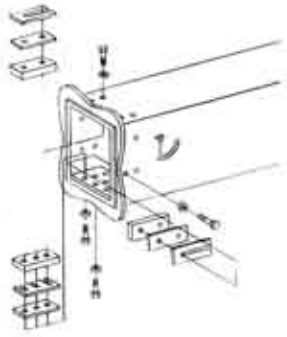
1. Loosen the bearing pad mounting bolts at locations "C" or "D" (or both) and add the required shims.
2. Shims are stamped with their Gradall Part Number and thickness. Check the shims already in place and make sure you are installing the right ones.
3. Apply ***LOCTITE* 242** to the threads on the pad mounting bolts.
4. Re-torque the bearing pad mounting bolts.
5. Remove wedge installed in Step 3.
6. Repeat "Inspection" Steps 3-6 and "Adjustment" Steps 1-5 for Area 1, Location "C".

CAUTION If a wedge was used to move the Boom-Sections for checking, **be certain it is removed** before activating the boom circuit. Failure to do so will damage the boom structure. Do not use more than one wedge at a time for the adjustment operation.

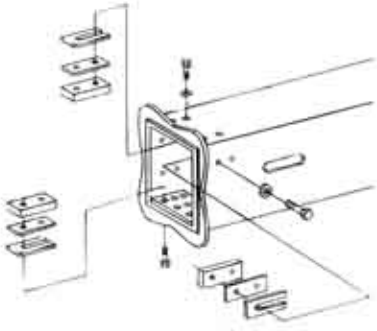
END VIEW AREA 1 & 2



BOOM-SECTION 1: AREA 1, FRONT INSIDE



BOOM-SECTION 2: AREA 2, FRONT INSIDE



SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

Note!

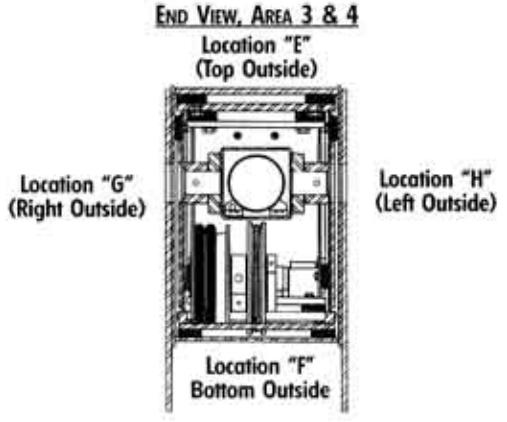
If two washers were installed under the head of the pad mounting bolts and a shim was added, it is imperative that one washer be removed. Otherwise the bolt will not secure the pad nut properly.

ADJUSTMENT PROCEDURE:

AREA 3 & 4 (PAD LOCATION "E" & "F")

→ **Inspection**

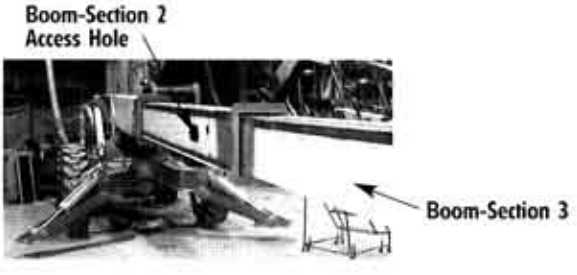
1. Retract the boom assembly within 1 ft. of full retraction.
2. Raise the boom assembly approximately 30° so that the weight of the assembly will force the boom package to rest against the bottom plate at the rear.
3. At the rear of the boom, use a feeler gauge to check the bearing pad clearance between Boom-Sections 1 & 2 and Boom-Sections 2 & 3 at Area 3 and the top of Area 4, Pad Location "E". Visually check pad location "F" at this time.



4. Lower and extend the boom until Boom-Section 3, Area 4, and all pad locations clear the access holes in Boom-Section 2 by at least 1 ft.
5. Using a feeler gauge, check the pad clearance for Area 4, Pad location "F". It may be possible for a boom to show the pad clearance when fully retracted and no pad clearance when extended. If no pad clearance is evident when extended, do not add shims at this time.
6. If there is more than $^{1}/_{16}$", shims must be installed to bring the boom into tolerance.

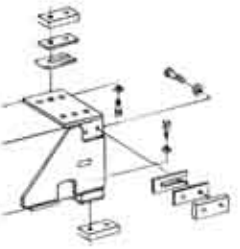
Note!

Shim pack levels should be equal top to bottom (within 1 shim) pad locations "E" and "F". If the shim pack level is unequal after this adjustment, equalize at the next adjustment.

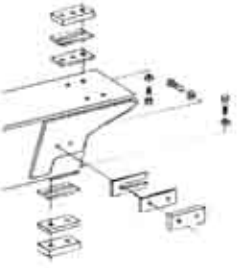


Boom Bearing Pads are now fully adjusted.

BOOM-SECTION 2:
AREA 3, REAR OUTSIDE



BOOM-SECTION 3:
AREA 4, REAR OUTSIDE



SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

Adjustment Procedure:

Area 4, (Pad Location "G" & "H")

→ **Inspection**

1. With the engine off, reach through the access hole, install a wedge between Boom-Sections 2 and 3 at Area 4, Pad Location "G". Force Boom-Section 3, Area 4 against the opposite side Pad Location "H" to check the clearance.
2. Using a feeler gauge, check the clearance between the boom and the bearing pad at Area 4, Pad Location "G".
3. If there is more than .060" clearance present, shims must be installed to bring the boom into tolerance.

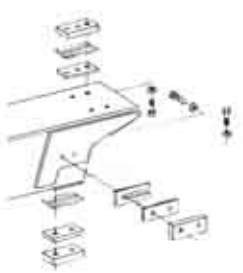
Note!

Shim pack levels should be equal side to side (within 1 shim), pad locations "G" and "H". If the shim pack level is unequal after this adjustment, equalize at the next adjustment.

→ **Adjustment**

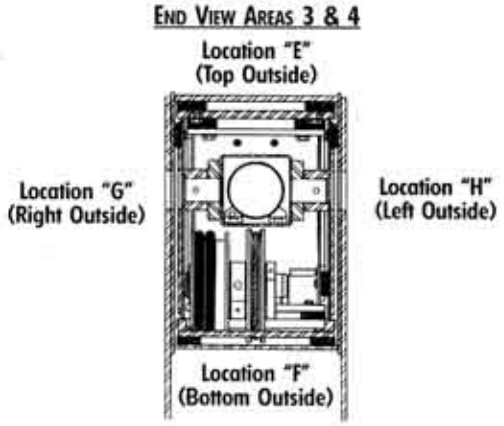
1. Loosen the bearing pad mounting bolts at location "G" or "H" (or both) and add required shims.
2. Shims are stamped with the Gradall Part Number and thickness. Check the part number on the shim being installed against the one previously installed to be certain they are the same.
3. Apply **LOCTITE 242** to the threads on the bearing pad mounting bolts.
4. Re-torque the bearing pad mounting bolts.
5. Remove the wedge installed under "Inspection", Step 1.

Boom-Section 3:
Area 4, Rear Outside



See note on page 2.0 for boom bearing pad bolt quantities

End View Areas 3 & 4



Boom-Section 2
Access Hole

Boom-Section 3
- Right side Location "G"
- Left side Location "H"

Inside View Location "G"
(From Opposite Side Access Hole)

ADJUSTMENT PROCEDURE:

AREA 3 & AREA 4 (PAD LOCATION "E", "F", "G" & "H")

→ **INSPECTION**

1. Raise the boom assembly to approximately 30° and retract to approximately 1ft. of full retraction. Shims for Area 3, Pad Locations "E", "F", "G" & "H" and Area 4, Pad Location "E" are added at the rear of the boom assembly.
2. Using a feeler gauge, measure the clearance between the boom and the bearing pad at all the above locations.
3. If there is clearance of more than 1/16" at Area 3 and/or Area 4 pad Location "E" and "F", shims are normally first added to Pad Location "E" at the rear of the boom assembly.

NOTE!

Shim packs should be equal (within 1 shim). Do not have more than one extra shim level at any bearing point.

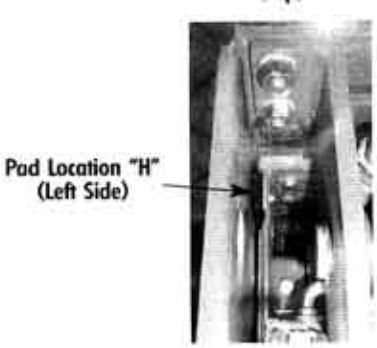
→ **Adjustment**

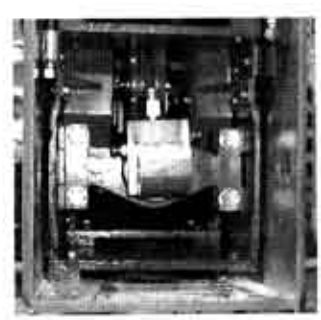
(Pad Location "F")

1. To add shims to Pad Location "F", wedge up the Boom-Section for clearance.
2. Shims are stamped with their Gradall Part Number and thickness. Check the part number on the shim being installed against the part number of the one previously installed to be certain they are the same.
3. Loosen bearing pad mounting bolt and install shims as required.
4. Apply ***LOCTITE* 242** to the mounting bolt threads.
5. Re-torque the bearing pad mounting bolts.
6. Remove any wedges you installed.

REAR VIEW

AREA 3





→ **Adjustment**
(Pad Locations "G" & "H")

1. To add shims to Area 3 or 4, Pad Location "G" or "H", install a wedge to Pad Location "G" to force the boom to the opposite side Pad Location "H".
2. Install a shim, remove the wedge and repeat step 29 on opposite side, Pad Location "H".
3. Apply **LOCTITE 242** to the bearing pad mounting bolt threads.
4. Re-torque the bearing pad mounting bolts.
5. Remove any wedges you installed.

REAR VIEW, TYPICAL

Pad Location "H" (Left Side)

Pad Location "G" (Right Side)

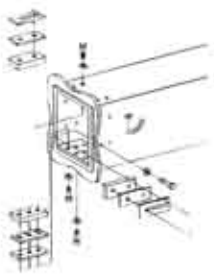
The Boom Bearing Pads are now fully adjusted.

AREA 1 AND AREA 2

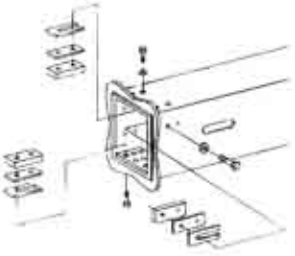
Bearing pad removal from Area 1 and Area 2 is accomplished with the boom extended approximately three fourths of the total stroke. If the pinch point is tight, you may have to remove shims and spacers from the opposite bearing pad.

Record quantities and Part Numbers of the spacers and shims removed from each location. This will assist you in reinstalling the bearing pad, spacer and shim package.

BOOM-SECTION 1:
AREA 1, FRONT INSIDE

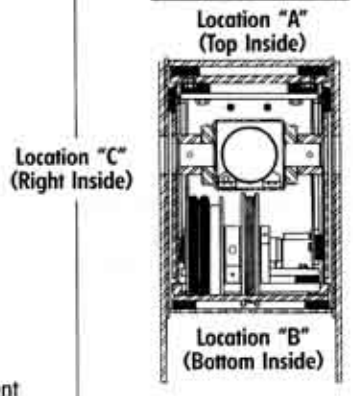


BOOM-SECTION 2:
AREA 2, FRONT INSIDE



SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

END VIEW AREA 1 & 2



→ **Removal**

Pad Location "A"

1. Raise the boom assembly approximately 1 ft. off the ground.
2. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the bearing pad mounting bolts and washers.
4. Remove the shims, spacers and the bearing pad.

→ **Removal**

Pad Location "B"

1. Lower the boom assembly to ground and apply minimal down-pressure, sufficient to provide clearance at Location "B".
2. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the bearing pad mounting bolts and washers.
4. Remove shims, spacers and bearing pads.

→ **Removal**

Pad Location "C" & "D"

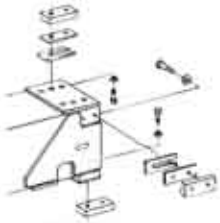
1. If the boom is tight, install a wedge to the side and force the boom to the opposite side.
2. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the bearing pad mounting bolts.
4. Remove shims, spacers and bearing pads.
5. Remove the wedge installed in Step 1.

Area 3 and Area 4, Pad Location "E"

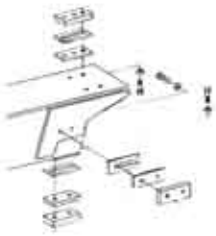
→ **Removal**

1. Steam-clean or pressure-wash the rear of the boom assembly.
2. Retract the boom fully, then extend 1 ft.
3. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
4. If necessary, use a wedge to shift the Boom-Section to the opposite side to create clearance for bolt removal. If additional clearance is required, remove the shim pack from the side opposite the bearing pad being removed.
5. Remove the bearing pad mounting bolts.
6. Remove shims, spacers and bearing pads.
7. Remove the wedge installed in Step 4.

Boom-Section 2:
Area 3; Rear Outside



Boom-Section 3:
Area 4; Rear Outside



See note on page 2.0 for boom bearing pad bolt quantities

Area 4

→ **Removal**

Pad Location "F"

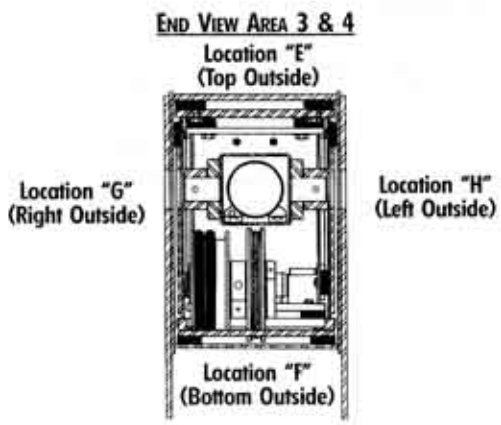
1. Extend Boom-Section 3 past the access holes in Boom-Section 2.
2. Lower the boom to 1 ft. off ground. The front of the boom will pivot down, creating clearance at Pad Location "F".
3. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
4. Through the access hole, remove the bearing pad mounting bolts at Pad Location "F".
5. Remove the shims, spacers and bearing pads.

→ **Removal**

Pad Location "G" & "H"

1. Extend Boom-Section 3 past the access holes in Boom-Section 2.
2. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Install a wedge at pad location "G" or "H" and force the Boom-Section to the opposite side.
4. Remove the bearing pad mounting bolts.
5. Remove shims, spacers and bearing pads.
6. Remove the wedge installed in Step 3.
7. Repeat Steps 2 thru 5 for opposite side bearing pad removal.

End View Area 3 & 4



GENERAL

- It may be possible for a bearing pad only to be installed if there is insufficient clearance for spacers or shims.
- If no spacer or shim is installed, or if only the spacer is installed with the bearing pad, use two (2) flat washers under the head of the bearing pad mounting bolt. This will ensure the bolt will not protrude past the chamfer on the pad.
- **Do Not** install a shim against a bearing pad. This will ruin the integrity of the fastener system.
- If there is not room for a spacer and a shim, use only the spacer.
- Use ***LOCTITE* 242** (Gradall P/N 1440-3364) on all bearing pad mounting bolts.
- Bearing pad mounting bolt torques are:
  $^3/_8$" bolt: 32-37 ft-lb
  $^1/_2$" bolt: 76-86 ft-lb
- **Do Not** overtorque mounting bolts. This could pull the bearing pad nut through the bearing, causing the bearing pad to fall out of the boom.
- Lube bearing pad slide paths.
- Shims and spacers are stamped with the Gradall Part Number and thickness. Check replacement parts against the original to be certain the correct parts are being used.

DANGER **Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel before working on or inside the boom.**

BEARING PAD INSTALLATION

1. Refer to bearing pad removal instructions for boom area and bearing pad placement, Sections 2 & 3.
2. Refer to the Part Numbers of shims and spacers removed.
3. Refer to the quantity of shims removed.
4. Place the new package (bearing pad, spacer and shims) to installation area using the same quantity that was removed.
5. **Do Not** install a shim directly against the bearing pad.
6. Install the bearing pad mounting bolts. Determine whether one or two flat washers must be used under the bolt head at this time.
7. Apply ***LOCTITE* 242** to the mounting bolt threads.
8. Torque the mounting bolts to 32-37 ft-lb ($^3/_8$" bolt) or 76-86 ft-lb ($^1/_2$" bolt).

Note!

After new bearing pads are installed, you will have to check the boom for correct adjustment. Readjust if necessary.

534C-9/C-10/& 534 D-9/D-10 Bearing Pad, Spacer, Shim Data: 40' & 45' Boom

Part Number	Pad	Shim	Spacer	Dimension	Boom-Section	Area	Location
9112-3018	X				3	4	B
9112-3019	X				2, 3	2, 3, 4	A, F
9114-3168	X				1, 2, 3	1, 2, 3, 4	A, C, G, H
9103-3186	X				1, 3	4, 1	A, C, D
9112-3021	X				2	2	C, D, G, H
9103-3185	X				1	1	A
9103-3187	X				1		Push Beam
9114-3083	X				1		Crowd Cylinder
9103-1236			X	.060"	1, 2, 3	1, 3, 4	A, C, D, G, H
9112-1083			X	.060"	2,3	2, 3, 4	A, F, C, D
9114-1302		X		.060"	1, 2, 3	1, 2, 3, 4	A, B, E
9114-1303		X		.060"	1, 2, 3	4	A, B, E
9020-5870		X		.060"	1, 2, 3	1, 2, 3, 4	A, C, D, G, H
9112-1082		X		.060"	2, 3	2, 3, 4	A, B, C, D, F
9112-1157		X		.134"			Strong Back
9112-1023		X		.060"			Strong Back
9112-1024		X		.036"			Strong Back

534C-6, & 534D-6 Bearing Pad, Spacer, Shim Data: 42' Boom

Part Number	Pad	Shim	Spacer	Dimension	Boom-Section	Area	Location
9112-3019	X				2, 3	3, 4	F
9108-3297	X				2, 3	3, 4	E
9103-3186	X				1, 2, 3	1, 3, 4	C, D, G, H
9112-3021	X				2	2	C, D
9108-3063	X				1, 2	2	B
9103-3185	X				1	1	A
9103-3187	X				**	**	**
9112-1081		X		.06	3	3, 4	A E
9020-5870		X		.06	1, 3	1, 3, 4	C, D, G, H
9112-1082		X		.06	2	2	C, D
9108-1171		X		.06	1	1	B
9112-1023		X		.0598	1		*
9112-1024		X		.0359	1		*
9112-1157		X		.1340	1		*
9108-1447			X	.132	3, 2	3, 4	E
9103-1236			X	.06	2, 3	3, 4	C, D, G, H
9112-1083			X	.06	2	2	A, C, D
9108-1172			X	.132	1, 2		B

* Rear of Boom, Crowd Cylinder Bracket

** Extension Cable Bracket

532C-6 & 534C-6 Bearing Pad, Spacer, Shim Data: 36' Boom

Part Number	Pad	Spacer	Shim	Dimension	Boom-Section	Area	Location
9112-3019	X				2, 3	2, 3, 4	A, F
9108-3297	X				2, 3	3, 4	E
9103-3186	X				1, 2, 3	1, 3, 4	C, D, G, H
9103-3185	X				1	1	A
9112-3021	X				3	4	G, H
9108-3063	X				1, 2, 3	1, 2	B, F
9103-3187	X						*
9108-1447		X		.132	3, 2	3, 4	E
9103-1236		X		.060	1, 2, 3	1, 3	A, C, D, G, H
9108-1172		X		.132	1, 2	1, 2	B
9112-1083		X		.060	2	2	A
9112-1081			X	.060	3, 2	3, 4	E
9112-1024			X	.0359	1		**
9112-1023			X	.0598	1		**
9020-5870			X	.060	2, 3	1, 2, 4	A, C, D, G, H
9112-1082			X	.060	1, 2	1, 2	C, D
9112-1157			X	.134	1		**
9108-1171			X		2	2	B

* Extension Cable Bracket
** Crowd Cylinder Mounting Bracket

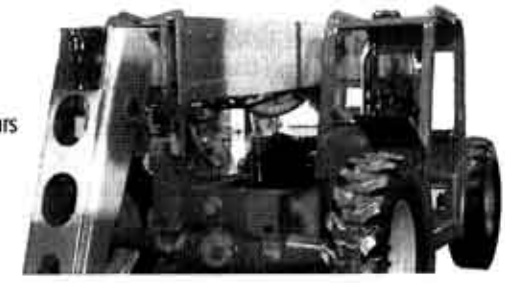
While the booms can be separated from each other on the machine, Gradall recommends against this procedure. It is much safer, more efficient and more cost-effective to remove the complete boom assembly from the machine and place it on stanchions (horses) for separation. Work can then progress at a normal working height.

(5A) REMOVAL OF THE COMPLETE BOOM ASSEMBLY FROM THE MACHINE

→ Preparation

1. Position the handler in a safe, level, open area away from personnel and equipment.
2. Apply the parking brake, shift the Forward/Reverse lever to "Neutral" and turn the rear wheels straight forward.
3. Level the boom assembly.
4. Turn off the ignition switch, remove the key and fasten a "do not operate" tag to the steering wheel.
5. Chock the wheels to prevent machine movement during removal operation.

MACHINE READY FOR BOOM REMOVAL: WHEELS STRAIGHT, BOOM LIFTED INTO PLACE, SLING AT BALANCE POINT



→ Stage 1

1. Procure a crane and lifting tackle capable of safely lifting 5000 lb.
2. Install a tag line to the front of the boom to help guide the boom once it clears the machine.
3. Fasten slings to Boom-Section 1 at the balance point.
4. Take the weight off the boom assembly.

→ Stage 2

1. Identify and tag all hydraulic hoses and electrical cables.
2. Separate, plug and cap all hoses and electrical cables. With the crowd cylinder hoses blocked off, the Boom-Sections will be locked in position, preventing run-out.
3. Carefully remove pins from the compensation and lift cylinders. Do not let the cylinders fall uncontrolled. Carefully place them in a position of rest. Block the lift cylinder in place to ensure it does not fall against the engine. Do not install blocking over the engine valve cover.

4. Confirm the crane still has the weight of the boom in a balanced position.
5. Carefully remove the boom base pivot pin.
6. Lift the boom assembly free of the machine and place in the designated work area.

BOOM BASE PIVOT PIN

(5B) Reinstalling the Complete Boom Assembly to the Machine

→ Preparation

- Select a work area with sufficient space to work safely and efficiently.
- Clean the work area.
- Procure tools required for this operation.
- Procure a crane or hoist and slings capable of lifting 5000 lb.
- If working with a helper, be certain each of you know your individual assignments.
- Mechanically fasten the Boom-Sections together to prevent unexpected uncontrolled movement if the crowd cylinder is removed or the crowd cylinder hydraulic line is opened or removed.
- Procure hydraulic fluid for topping off the hydraulic system. Use only Gradall–approved fluids.

Machine Ready for Boom Reinstallation: Wheels Straight, Boom Lifted into Place, Sling at Balance Point

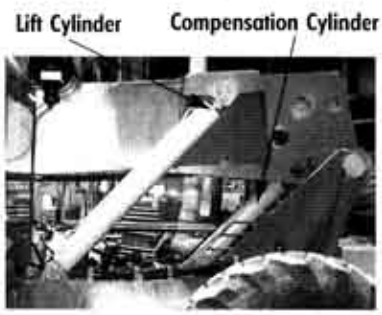
→ Stage 1

1. Install slings around the boom assembly at the balance point.
2. Make a trial lift to be certain the balance point is correct.
3. Connect a tag line to the front of the boom assembly to aid placement of the assembly.
4. Lubricate all cylinder and boom assembly mounting wear bushings and pins.
5. Lift the assembly and position the mounting base for pivot pin installation.
6. Install the mounting base pin and lock in position using a stover nut.
7. Position the boom assembly bores correctly to install the cylinder pins.

Note!

Using the sway circuit will aid Steps 5, 6, and 7.

8. Install the cylinder pins and lock in position using **LOCTITE 242** (Gradall P/N 1440-3364) on the pin keeper threads.



Boom Base Pivot Pin Location

→ **Stage 2**

1. Apply **LOCTITE 545** (Gradall P/N 1440-4043) to all hydraulic fittings.
2. Connect all hydraulic hoses to the proper circuits and torque. Refer to identification tags applied during removal operation.
3. Connect auxiliary electrics if the machine is so equipped.
4. Check the torque on all mounting and cylinder locking pins.
5. Refill the hydraulic system (if necessary).

→ **Stage 3**

1. Remove lifting tackle and tag line.
2. Drive the machine to an area with sufficient space for full boom circuit operation.
3. Start up the machine and cycle all boom functions a sufficient length of time to warm up the hydraulic system to at least 120°F.
4. After completion of Step 3, check all circuits for hydraulic leaks, correcting where necessary.
5. Re-check the hydraulic system capacity level; fill up if necessary.

→ **Stage 4**

1. Inspect boom bearing pads for correct adjustment. If adjustment is required see Section 2, "Boom Adjustment".
2. Inspect retraction and extension cable for proper installation and adjustment. If adjustment is required, see Section 7.
3. Inspect hydraulic hose installations to ensure they are not rolling under twist. If they are under twist, readjust by loosening fittings and clamps to relieve the twist. Re-torque using two wrenches at the fittings. Tighten all hose clamps.
4. Inspect auxiliary circuit electric cable for proper installation. It should be tight and roll simultaneous with the auxiliary hydraulic hoses. Correct if necessary.

The Boom should now be properly installed and ready to return to service.

(5C) Separating Boom-Sections 2 and 3 From Boom-Section 1

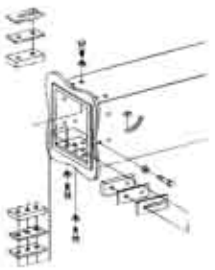
→ Preparation

- Review all Safety issues before commencing.
- Select a safe, clean area with sufficient space to work on the assembly.
- Procure lifting tackle and a crane capable of lifting 5000 lb.
- Place the boom assembly upside down (inverted 180°) on stanchions.
- If working with a helper, be certain each of you know your individual assignments.
- Procure tags for identification of hoses and components removed.
- Designate area placement of removed components.

Stage 1

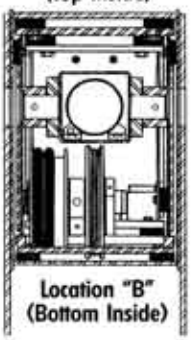
→ **1.** Remove all bearing pads at the front inside of Boom-Section 1, Area 1, Pad Locations A, B, C, D.

Boom-Section 1
Area 1: Front Inside

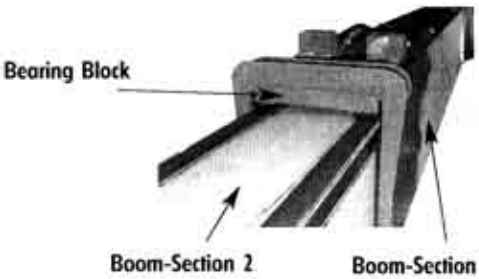


See note on page 2.0 for boom bearing pad bolt quantities

End View Area 1 & 2



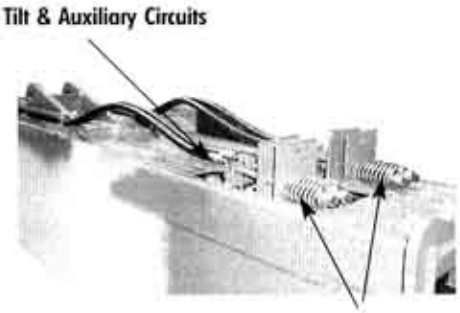
2. Remove the bearing block from the front inside of Boom-Section 1, Area 1.



Note! *Boom-Sections Upside-Down*

3. Loosen the hose take-up brackets.

4. Separate, plug and cap tilt circuit (and auxiliary) hydraulic hoses inside the boom at the hose take-up bracket.



Note! *Boom Upside-Down*

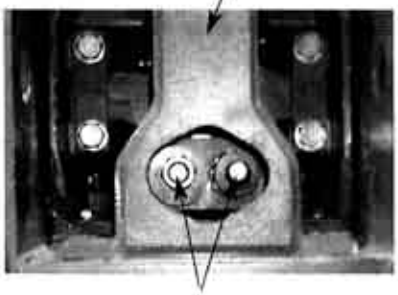
5. If auxiliary electrics are present, separate the electric plug at the hose take-up area.

→ **Stage 2**

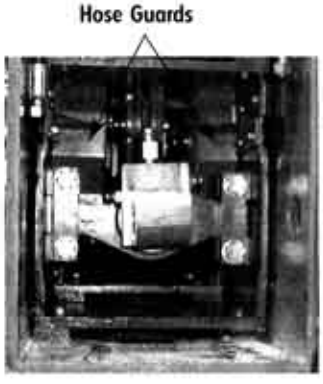
1. Loosen the retraction cable and remove all fasteners from the retraction cable adjusting block, located at the front of Boom-Section 1.

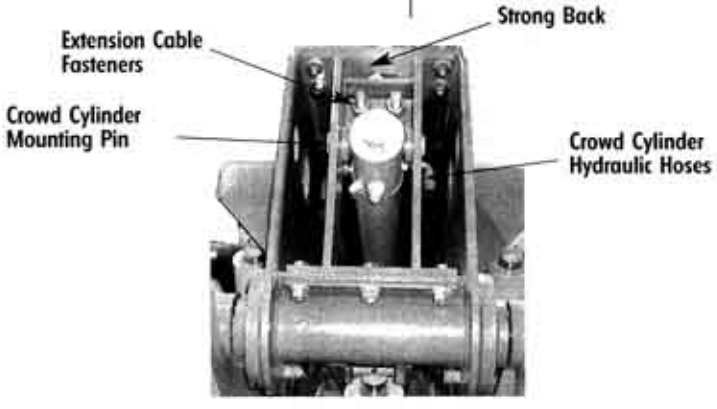
Retraction Cable Adjusting Block

Block and Fasteners



2. At the rear of the boom assembly (strong back/cylinder bracket), remove all fasteners from the extension cables, using one wrench to hold and one to turn.
3. Separate, cap and plug the crowd cylinder hydraulic hoses.
4. Remove the crowd cylinder mounting pins and fasteners.
5. At the rear of the boom assembly, remove the hose guards.
6. Remove the strong back (cable bracket) from the rear of the boom assembly.





→ **Stage 3**

1. Fasten lifting tackle to Boom Sections 2 and 3, lift and partially pull out of Boom Section 1.
2. Place stanchions under Boom Sections 2 and 3 and take off the weight, letting them rest on stanchions.
3. Reinstall lifting tackle at the balance point of Boom Sections 2 and 3 and slowly extract them from Boom Section 1, protecting all hydraulic hoses and cables.
4. Place Boom Sections 2 and 3 in the designated work area for the next operation.

(5D) Separating Boom-Section 3 from Boom-Section 2

The procedures listed in this section are complete for separating Boom-Sections from each other. Reassembly procedures are given in Section 6, *"Assembling Boom-Sections 1, 2 & 3"*. These procedures are given using shop conditions only, with the Boom-Sections inverted 180° (upside down).

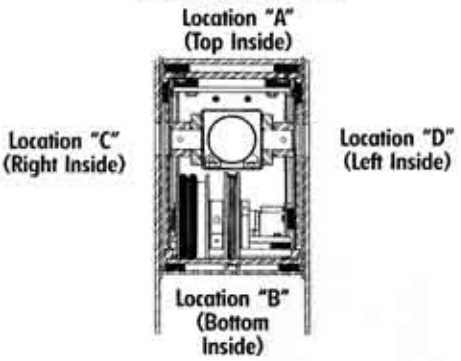
→ Preparation

- Review preparation parameters from Section 5C.
- Review all Safety Issues.
- Select an appropriate place to store Boom-Section 3 after removal from Boom-Section 2

→ Stage 1

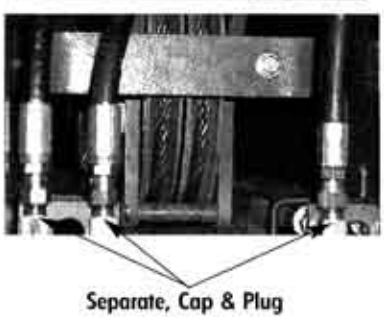
1. Remove all bearing pads from the inside front of Boom-Section 2, Area 2, Pad Locations A, B, C, D.

End View Area 1 & 2



2. Separate, plug and cap tilt circuit hydraulic hoses (and auxiliary circuits) at the inside front of Boom-Section 3 at the boom head section.

Tilt & Auxiliary Circuit Hoses - Step 2

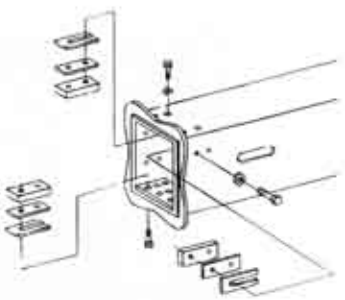


3. **534C-9/C-10 & 534D-9/D-10:**
   Remove all extension cable sheave components from the pivot beam front.
4. **532C-6, 534C-6 & 534D-6:**
   Remove extension cable sheave bracket fasteners from the front of the crowd cylinder.

Extend Cable Sheave Front Section #3

5. **532C-6, 534C-6 & 534D-6:**
   Pull extension cable sheave bracket free of Boom-Section 3 and set aside for repair or reinstall.

Boom-Section 2:
Area 2, Front Inside

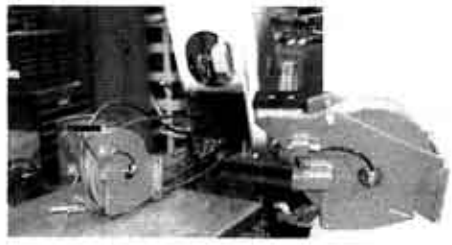


See note on page 2.0 for boom bearing pad bolt quantities

534C-9/C-10 & 534D-9/D10:
Extend Cable Sheave & Push Beam

5. **532C-6, 534C-6 & 534D-6:**
Pull extension cable sheave bracket free of Boom-Section 3 and set aside for repair or reinstall.

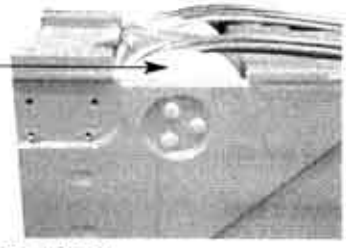
532C-6, 543C & D-6
EXTENSION CABLE BRACKET



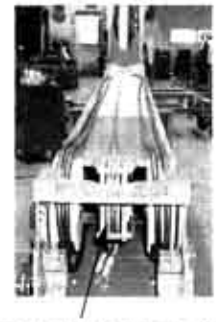
6. Pull the extension cables free of the sheave brackets and lay them on the boom.

→ **Stage 2**

1. At the rear of the boom, remove all retraction cable sheave components.
2. Remove hydraulic hose rollers and components.



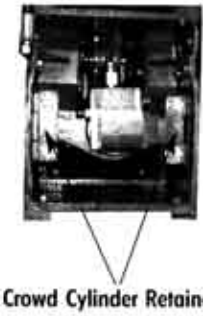
REAR SECTION 2 & 3:
HOSES AND RETRACTION CABLE



Retraction Cable Sheave, Step 1

3. **532C-6, 534C-6 & 534D-6:**
Remove crowd cylinder retainers.

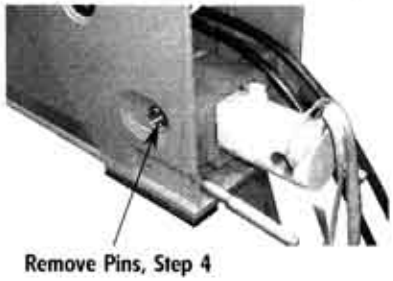
532C-6, 534C-6 & 534D-6



Crowd Cylinder Retainers

4. **534C-9/C-10 & 534D-9/D-10:**
Remove all push beam pins and fasteners.

PUSH BEAM MOUNTING PIN AREA



Remove Pins, Step 4

534C-9/C-10 & 534D-9/D-10

Push Beam

→ **Stage 3**

1. **534C-9/C-10 & 534D-9/D-10:** From the front of Boom-Section 3, pull the push beam free of the boom assemblies.

2. **532C-6, 534C-6 & 534D-6:** From rear of Boom-Section 2 pull the crowd cylinder free of the boom assembly.

3. Place hydraulic hoses and cables inside Boom-Section 3 for protection.

Boom-Section 3, Front Inside: Cable & Hoses Inside Boom

532C-6, 534C-6 & 534D-6

→ **Stage 4**

1. Install lifting tackle to Boom-Section 3.
2. Take the weight and pull Boom-Section 3 from Boom-Section 2 far enough to rest at the balance point.
3. Place stanchions under Boom-Section 3 and release the weight, letting it rest on the stanchions.
4. Reinstall lifting tackle at Boom-Section 3 balance point and slowly extract it from Boom-Section 2.
5. Place Boom-Section 3 in the designated work area for the next operation.

The Boom-Sections are now separated. No special instructions are required for component removal and/or replacement. Refer to "Section 6" for reassembly of Boom-Sections.

The procedures listed in this section are complete for assembling the bare boom weldment to final assembly of the boom. Assembly procedures start with Boom-Section 3, followed in order by Boom-Sections 2 and 1. They also are given using shop conditions only, with the Boom-Sections inverted 180° (upside-down).

The instructions cover all 532 and 534 "C" and "D" series booms of any length. Deviations from standard procedures that cover all models are indicated with appropriate notations.

It would not be practical to attempt to cover every repair situation that might occur in the field. Therefore, these instructions cover the complete boom assembly and individual components. You may have to adapt these procedures to fit specific field situations.

⚠ CAUTION!

- Use **LOCTITE 242** (Gradall P/N 1440-3364) on all bolt threads.
- Use **LOCTITE 545** (Gradall P/N 1440-4043) on all hydraulic tube fittings.
- Torque fasteners and hydraulic fittings to the values given in Appendix "A" & Appendix "B".
- Shim bearing pads to 1/16" of tight fit. You may have to final adjust the bearing pads after the boom is installed on the machine and hydraulic power is available.
- Follow instructions given in Section 2 for bearing pad adjustment.
- Coat the interior of all bushings and sheaves with *Mystik Tetrimoly* grease (Gradall P/N 1440-4595) prior to installation of pins and bushings.
- Bearing pads and slide areas must be lubricated with *Mystik Tetrimoly* grease or equivalent.

Note!

Assembly of the Boom-Sections is quite complex. Close attention to the instructions is extremely important. Normal mechanic's tools are required, as well as a hoist capable of lifting 5000 lb. to handle the weight of the complete boom assembly.

(6A) Boom-Section 3 Assembly

→ Preparation

- Select an area with sufficient space to work safely and efficiently.
- Clean the work area.
- Procure all tools and lifting devices required for this operation.
- Use crane capable of lifting 5000 lbs.
- Gather and identify parts to be used.
- If working with a helper, be certain each of you know your individual assignments.
- Use stanchions (work horses) of sufficient capacity to hold boom assemblies safely.

→ Stage 1, Boom Weldment, Bearing Pads

1. Place Boom-Section 3 upside-down on stanchions.

Boom-Section 3, Upside-Down

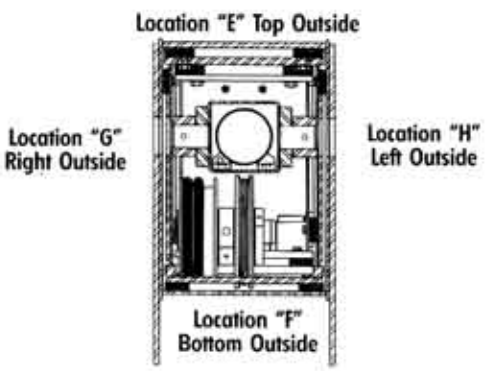
2. Clean the inside and outside boom surfaces.
3. Inspect tilt carriage bushings in the boom head section for damage or excessive wear. Bushing ID when new is 2.511-2.512". Replace if worn more than 1/16" or damaged.

4. Install bearing pads, spacers and shims to the rear of the boom, Area 4, at the following locations:
   534C-6/534D-6; All pad locations.
   534C-9/C10, 534D-9/D10; Locations "B", "C", & "D".

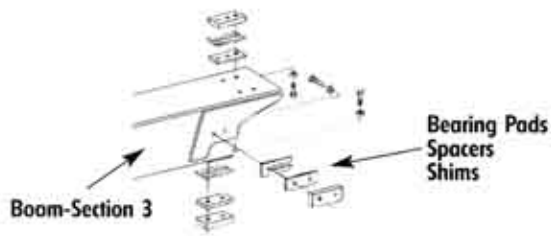
Note!

Do Not install spacers and shims to bearing pads at Location "E" at this time. This will make insertion into Boom-Section 2 easier.

END VIEW AREA 3 & 4



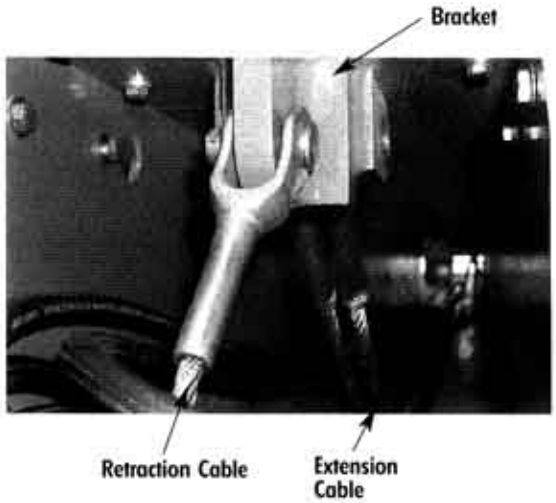
BOOM-SECTION 3
AREA 4, - REAR OUTSIDE



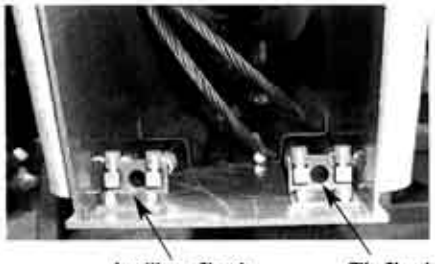
SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

→ **Stage 2, Cables and Hoses**

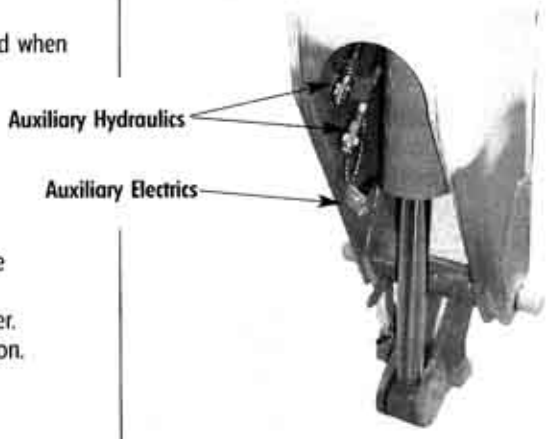
1. Install single retraction cable and double extension cable to the bracket at the inside rear of the boom.



2. Install tilt circuit hoses and auxiliary circuit hoses and electric cables and brackets inside protected areas.
3. Bolt hose brackets in place at the front of the boom.

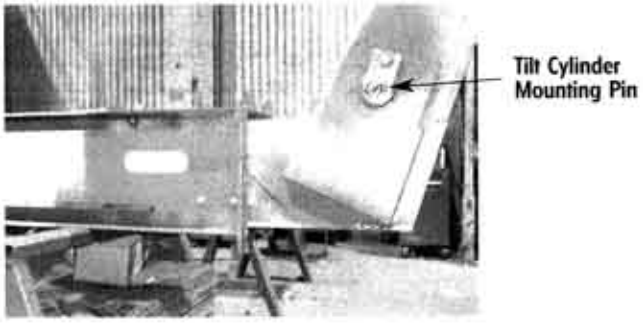


4. Lubricate Bearing pad paths.
5. Lay cable and hose inside Boom-Section 3 to protect against being pinched when installed into Boom-Section 2.



→ **Stage 3, Tilt Cylinder and Auxiliary Circuits**

1. Install hoses for the tilt cylinder.
2. Install hoses and electric cables for any auxiliary circuits.
3. Lift the tilt cylinder and place it inside the boom head section, lining up the mounting pin bores.
4. Install the mounting pin through the boom head section and the tilt cylinder.
5. Apply ***LOCTITE* 242** to the keeper bolt and lock the mounting pin in position.



Boom-Section 3 is now ready for insertion into Boom-Section 2.

(6B) Boom-Section 2 Assembly

→ Preparation

- Clean the work area.
- Gather and identify parts to be used.
- If working with a helper, be certain each of you knows your individual assignments.
- Procure proper lifting tackle to safely lift and install components to each other.
- Use stanchions of sufficient capacity to hold Boom-Sections 1 & 2.
- Be certain the work area has sufficient space to work safely.

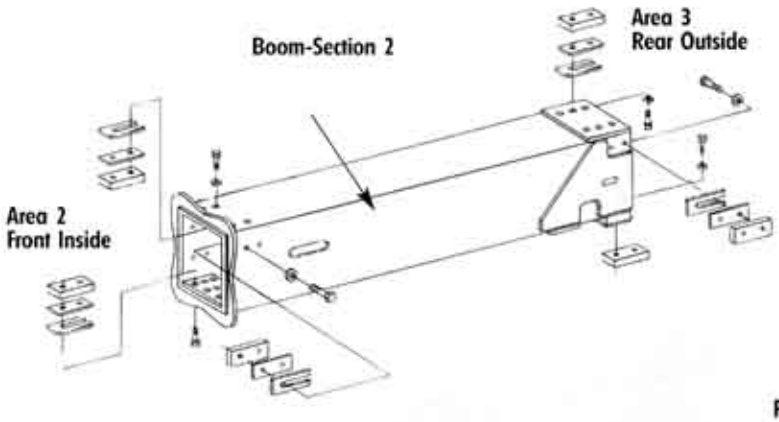
Assembly

→ Stage 1, Boom Weldment, Bearing Pads

1. Place Boom-Section 2 upside-down on stanchions.
2. Clean the inside and outside of Boom-Section 2 thoroughly.
3. Lubricate the inside of the boom at the bearing slide path area.
4. Install Boom-Section 3 into Boom-Section 2. Install through the front of Boom-Section 2.

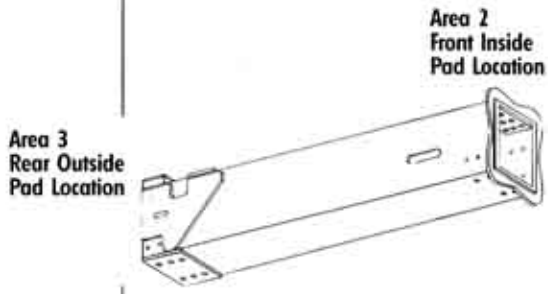
Typical Installation

5. Install bearing pads, spacers and shims to the rear boom Area 3 and front boom Area 2. **Do Not install pads to locations "F" and "H" yet.** This will make insertion into Boom-Section 1 easier.
6. Install bearing pads, spacers and shims at Pad Location "E" (See Section 6A, "Boom-Section 3 Assembly," Stage 1, Step 4 on page 6.1).



See note on page 2.0 for boom bearing pad bolt quantities

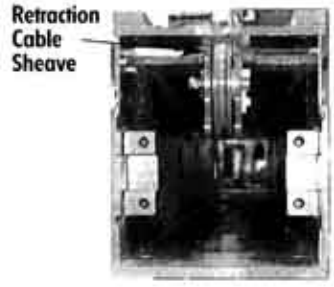
Boom-Section 2 (Upside-Down)



→ **Stage 2, Retract Cable and Hose Sheaves**

532C-6, 534C-6 & 534D-6 ONLY!

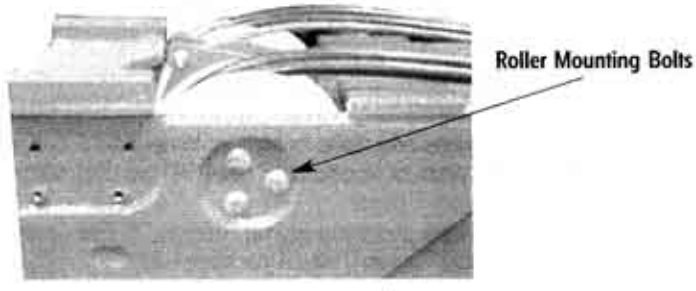
1. Install the retraction cable sheave to the bracket at rear of Area 3.
2. Install the cable around the sheave and lock it in place using ***LOCTITE* 242** on threads.
3. Install the cable adjustment block to the cable at the other end.



RETRACTION CABLE ADJUSTMENT BLOCK

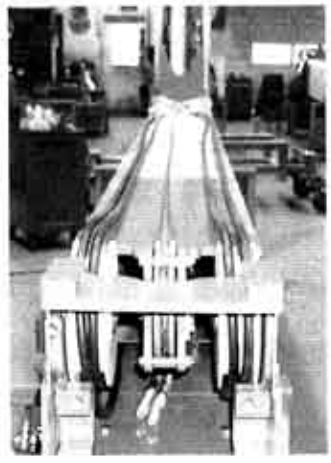
4. Install the tilt (and auxiliary electric/hydraulic) circuit hose rollers and hoses to the rear of the boom at Area 3.

HOSE ROLLERS AND HOSES



5. Lay out hoses and cable to the top of the boom in preparation for installation into Boom-Section 1.
6. Lubricate all bearing pad slide surfaces.

BOOM-SECTIONS 2 & 3 UPSIDE-DOWN:
STANDARD & AUXILIARY CIRCUITS INSTALLED



→ **Stage 3, Crowd Cylinder**

532C-6, 534C-6 & 534D-6 ONLY!

Install the crowd cylinder into the boom assembly. The crowd cylinder is installed through the rear of the boom assembly.

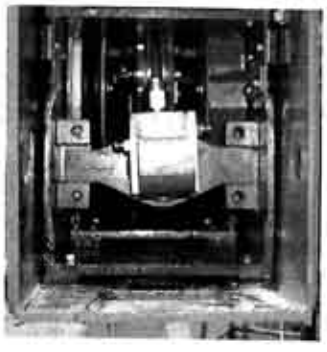
1. Clean the threads at the extension cable sheave mounting area.
2. Feed the cylinder into the boom until the base anchor area is secured into the bracket at the rear of Boom-Section 2.
3. Install the crowd cylinder retainers and torque the bolts to 340-365 ft-lb.

Crowd Cylinder Mounting Bolts Extension Cable Sheave

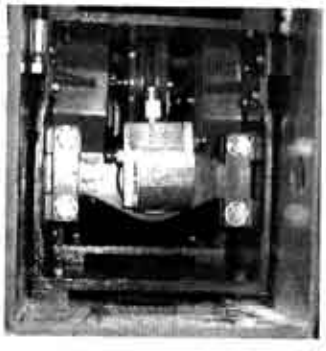
Crowd Cylinder

534D-6 Crowd Cylinder Base End

Rear of Booms: Crowd Cylinder Installed into Brackets



Retainer Plates Installed & Torqued

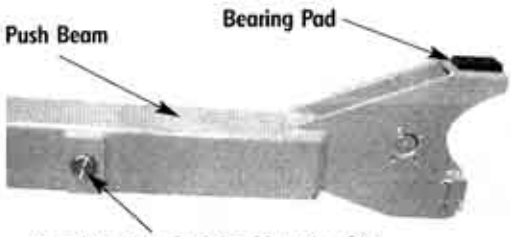


→ Stage 3, Crowd Cylinder & Push Beam Assembly

534C-9/C-10 & 534D-9/D-10 ONLY!

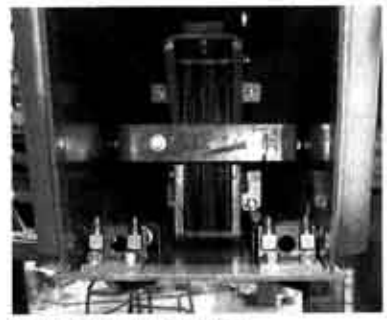
Part One

1. Clean the push beam weldment and all parts for the extension sheave assembly.
2. Install the crowd cylinder into the push beam.
3. Install the mounting pin and hardware at the crowd cylinder rod eye.

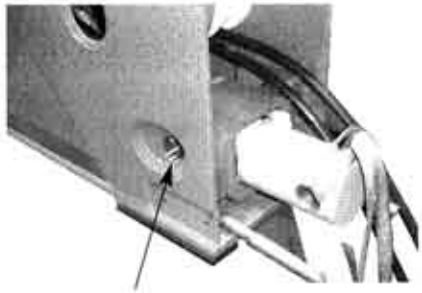


4. Through the front of Boom-Section 3, partially insert the push beam leaving the sheave bracket extended for accessibility.
5. Install the extension cables and feed the threaded end through the sheave bracket. The cable end will not feed through the sheave bracket with the sheave installed.
6. Lay out the cables over boom head toward the rear of boom assembly.
7. Install the extension cable sheave assembly complete; ie. sheaves, pins, lube system, bearing pads.
8. Feed the cables around the sheave.
9. Install the cable guide and guide bar.
10. Install the push beam mounting pins and locking hardware at the rear of Boom-Section 2.

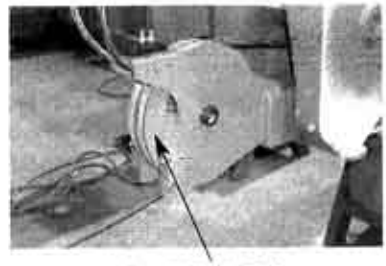
EXTENSION SHEAVE BRACKET: FRONT CROWD CYLINDER



Cable Guide & Guide Bar



Install Mounting Pins Here



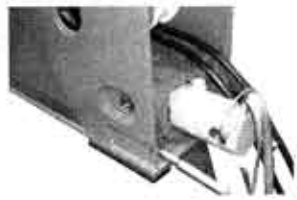
Install Cable Before Sheave Components

Part Two

1. Install the push beam fully into Boom-Section 2, lining up the mounting pin bores.
2. Install the push beam mounting pins and locking hardware at the rear of Boom-Section 2.

Mounting Pin Area

PUSH BEAM MOUNTING PIN AREA



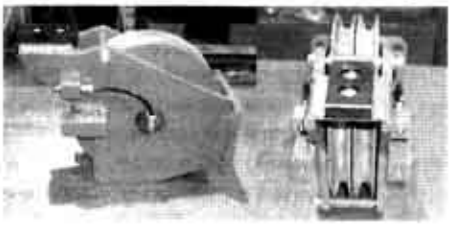
Boom-Sections 3 & 2 are now ready for insertion into Boom-Section 1.

→ Stage 4, Extension Cable Sheave

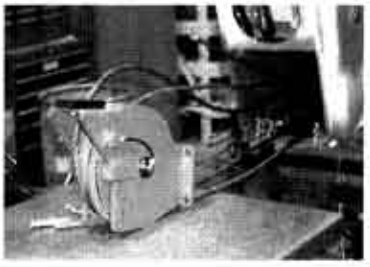
532C-6, 534C-6 & 534D-6

1. Gather and clean parts to assemble the cable extension sheave.
2. Assemble the extension cable sheave bracket assembly. See the appropriate current *Gradall Parts Manual* for applicable parts.
3. Place the cable extension sheave bracket on the work table, in front of Boom-Section 3.
4. Feed the extension cable around the sheaves in the bracket.
5. Install the cable guards on the sheave assembly.

Extension Cable Sheave Bracket Assembly



Extension Cable (Steps 3 & 4)

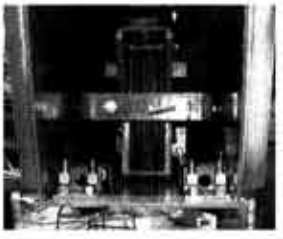


6. Pulling the cables to the rear of the boom assembly, install the sheave bracket on the crowd cylinder mounting bolts.
7. Install and torque the nuts at the crowd cylinder and the cable extension bracket.
8. Install the guide bar to the cable extension sheave bracket.

Crowd Cylinder Mounting Bolts

Extension Cable Installed on Sheave

Guide Bar



(6C) Boom-Section 1 Assembly

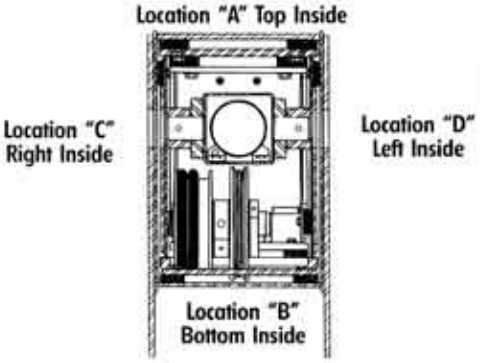
→ Preparation

- Clean the work area.
- Gather and identify all the parts to be used.
- Use stanchions of sufficient capacity to hold Boom-Sections 1, 2 & 3.
- Be certain the work area has sufficient space to work safely.
- If working with a helper, be certain each of you knows your individual assignments.
- Review the assembly operation for this Boom-Section.

→ Stage 1, Boom Weldment

1. Place Boom-Section 1 upside-down on stanchions.
2. Clean the inside and outside of Boom-Section 1 thoroughly.
3. Lubricate the inside of the boom at the bearing slide path area.

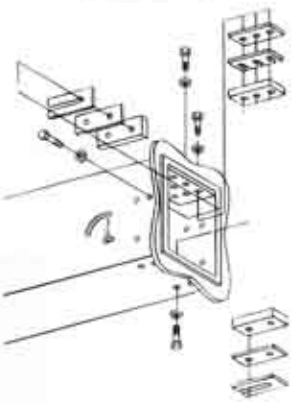
End View Area 1 & 2



4. Through the front of Boom-Section 1, install Boom-Sections 2 & 3.

Typical Installation

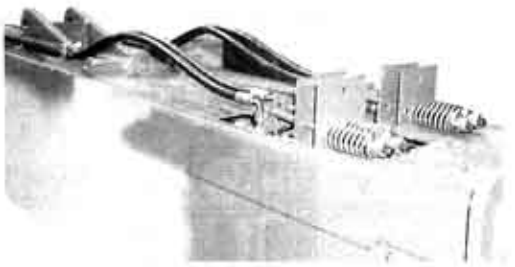
View with Boom-Section 1: Upside-Down



See note on page 2.0 for boom bearing pad bolt quantities

→ Stage 2, Bearing Pads & Hose Take-Up Assembly

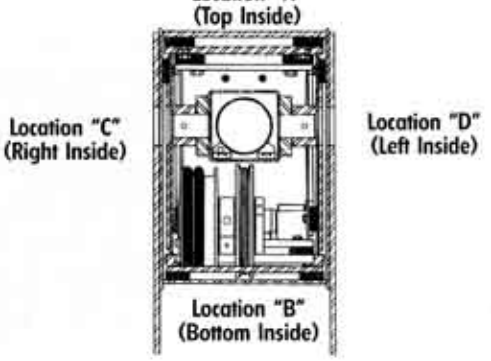
1. Install hose take-up assembly components to the front of the boom. Tighten components and fasten all hoses.
2. Install the retraction cable adjusting block. **Do Not tighten the cable yet!**

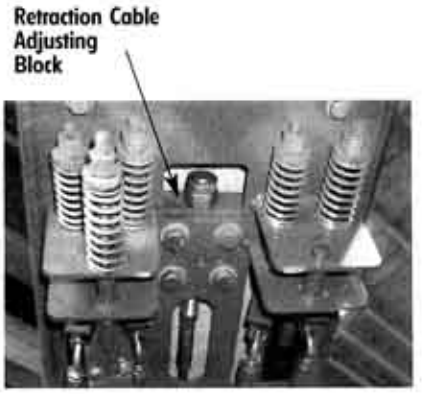


3. Install bearing block to the front inside of Boom-Section 1. This is the block on which the boom bearing pads mount at Area 1, Pad Location "B".

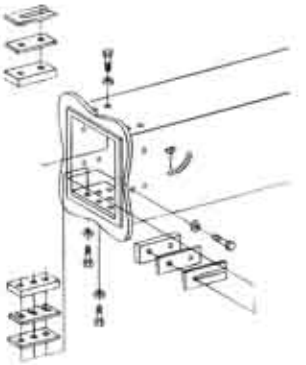
4. Install bearing pads, spacers and shims at Area 1, Pad Location A, B, C, D.
5. Torque the bearing block bolts 265-290 ft-lb and bearing pad mounting bolts to 68-78 ft-lb using ***LOCTITE* 242** on threads.

END VIEW AREA 1 & 2





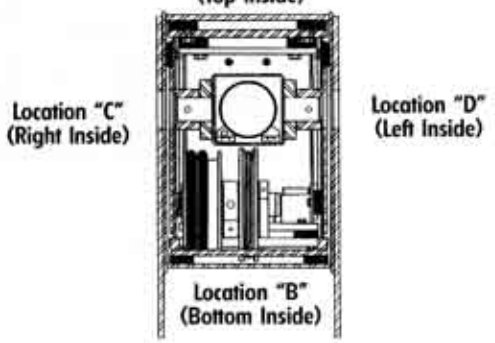
AREA 1 FRONT INSIDE - BOOM-SECTION 1



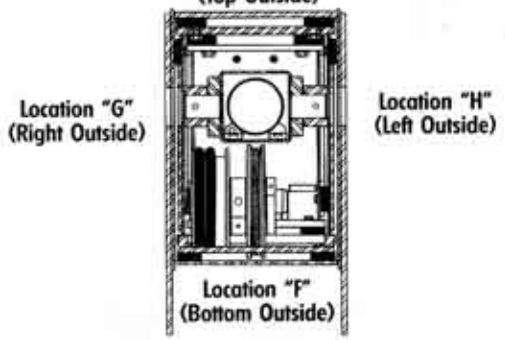
SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

6. Install and adjust bearing pads at Pad Location "F" & "H" (See 6B, Boom Section 2 Assembly. Stage 1, Step 5 on page 6.4).
7. Adjust the front inside pads at Area 1 and 2 Pad Locations A, B, C, D.
8. If necessary, at the rear of the boom assembly, readjust the bearing pads at Areas 3 and 4.

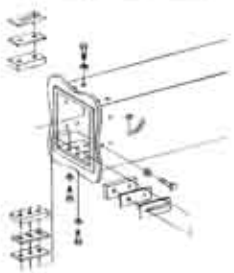
END VIEW AREA 1 & 2



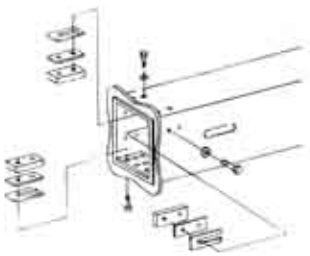
END VIEW AREA 3 & 4



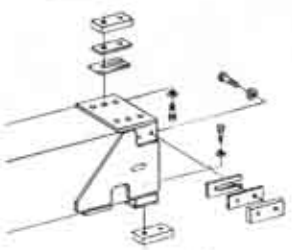
BOOM-SECTION 1
AREA 1, FRONT INSIDE



BOOM-SECTION 2
AREA 2, FRONT INSIDE



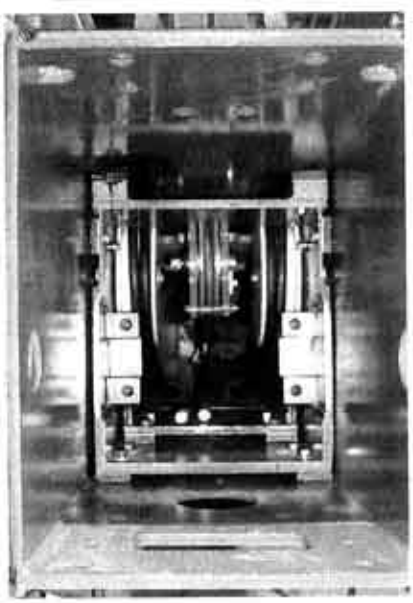
BOOM-SECTION 2
AREA 3, REAR OUTSIDE



BOOM-SECTION 3
AREA 4, REAR OUTSIDE

SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

BOOM ASSEMBLY REAR AREA 3 & 4

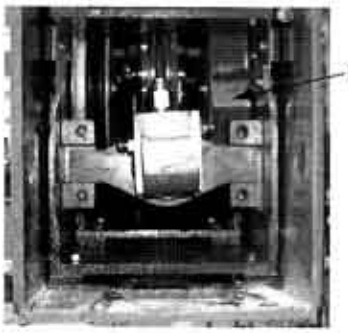


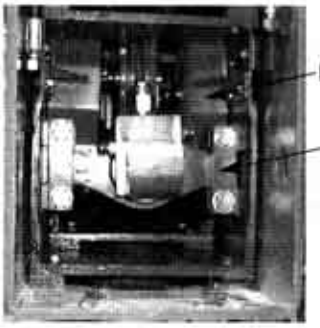
→ **Stage 3**

Boom Assembly Rear, Crowd Cylinder and Mounting Bracket, Extension & Retraction Cables

532C-6, 534C-6 & 534D-6 ONLY!

1. Install the standard and auxiliary circuit hose guards at the sheave area located in the rear of the Boom.

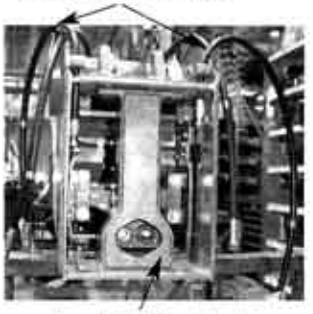


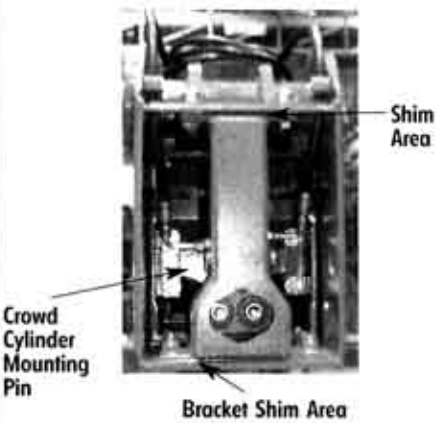


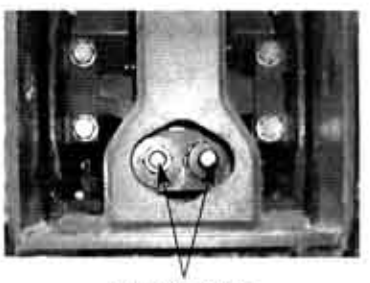
2. Place the crowd cylinder bracket inside the rear of Boom-Section 1. **Do not bolt in place yet!**
3. Insert the extension cables through the adjustment holes in the crowd cylinder mounting bracket. Make sure the cables are not crossed.
4. Install the crowd cylinder rod eye in the bracket. Lock it in place with the pin and snap rings.
5. Install the crowd cylinder bracket fasteners.
6. Measure the top and bottom clearance between Boom-Section 1 and the crowd cylinder bracket.
7. Install shims as required between the crowd cylinder and Boom-Section 1.
8. Torque the crowd cylinder bracket mounting bolts (see Appendix A), and apply ***LOCTITE* 242** to threads.
9. Install springs and nuts on the extension cables.
10. Tighten the retraction cable at the adjusting block.
11. Tighten the cable until its end lines up with the front of the cable adjustment access hole. When tightening, make sure that the wire rope is not turning.
12. **534C-9/C-10 & 534D-9/D-10:**
    The cable is tightened until the third thread from the end lines up with the cable adjustment access hole. When tightening, make sure that the wire rope is not turning.
13. Tighten the extension cables' adjusting nut until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the cable is not turning.
14. Install and torque the cable jam nuts to 100 ft-lb.
15. Install all hydraulic circuit hoses to the crowd cylinder.

Note!

See Stage 4 for 534C-9/C-10 & 534D-9/D-10 Strong Back Installation.



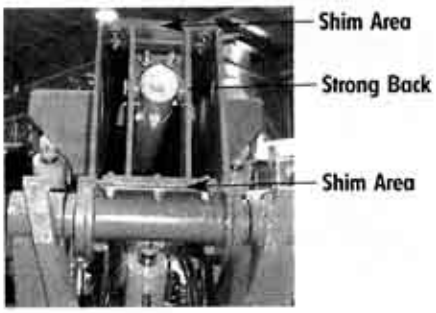




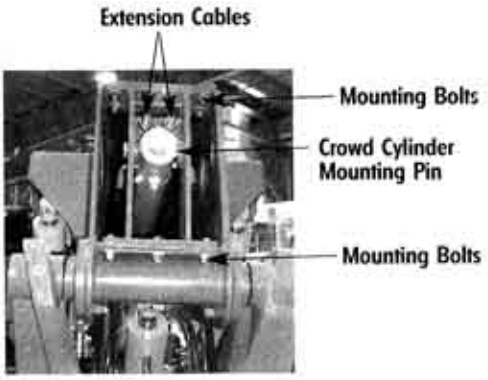
→ Stage 4, Strong Back Installation

534C-9/C-10 & 534D-9/D-10 ONLY!

1. Place the strong back in place at the rear of Boom-Section 1.
2. Install and lock the crowd cylinder mounting pin.
3. Measure the clearance between the top and bottom of the strong back to Boom-Section 1.
4. Install shims as required at the top and bottom of the strong back.

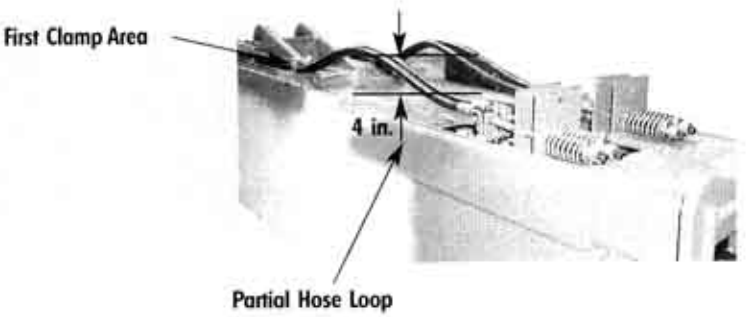


5. Install and torque the strong back mounting bolts.
6. Install extension cables and hardware into the strong back.
7. Tighten the extension cables' adjusting nut until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the cable is not turning.
8. Torque cable jam nuts to 100 ft-lb.
9. Install the crowd cylinder hoses.

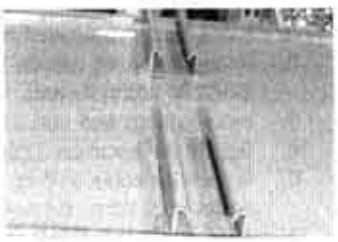


→ Stage 5, Hose Take-Up Assembly, Hydraulic Hoses & Clamps

1. Install the hose clamps for the tilt and auxiliary circuit hoses. **Do Not tighten them yet!**
2. At the area between the hose take-up bracket to the first hose clamp, adjust the hoses to form a 4" partial loop from the bottom of the boom to the hoses.
3. Tighten all hose clamps.



CHANNEL USED FOR HOSE CLAMPS; TYPICAL

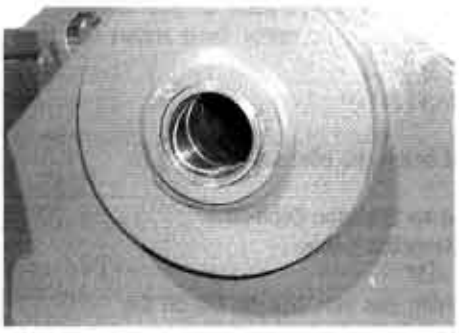


HOSE CLAMP; TYPICAL

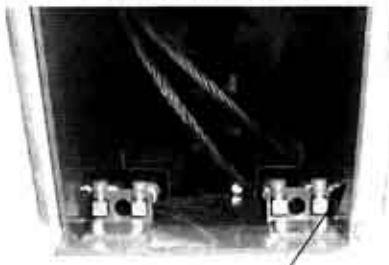
4. Connect Quick-Disconnect tilt circuit hoses (and auxiliary circuits) located at the boom head area of Boom-Section 3 to the fittings at the front of Boom-Section 3.
5. Install the lift cylinder bushings.

Boom-Section 3, Head

Lift Cylinder Bushing



Boom-Section 3, Front



Auxiliary Hydraulic and Electric Connection

7.0 Boom Cables

The extension/retraction cables are made from wire rope. Review the reference to Boom Cables in the "Safety" section of this Manual for safety related parameters. The boom cables are an important component of your Gradall Material Handler. They mechanically provide the extension/retraction force of Boom-Section 3.

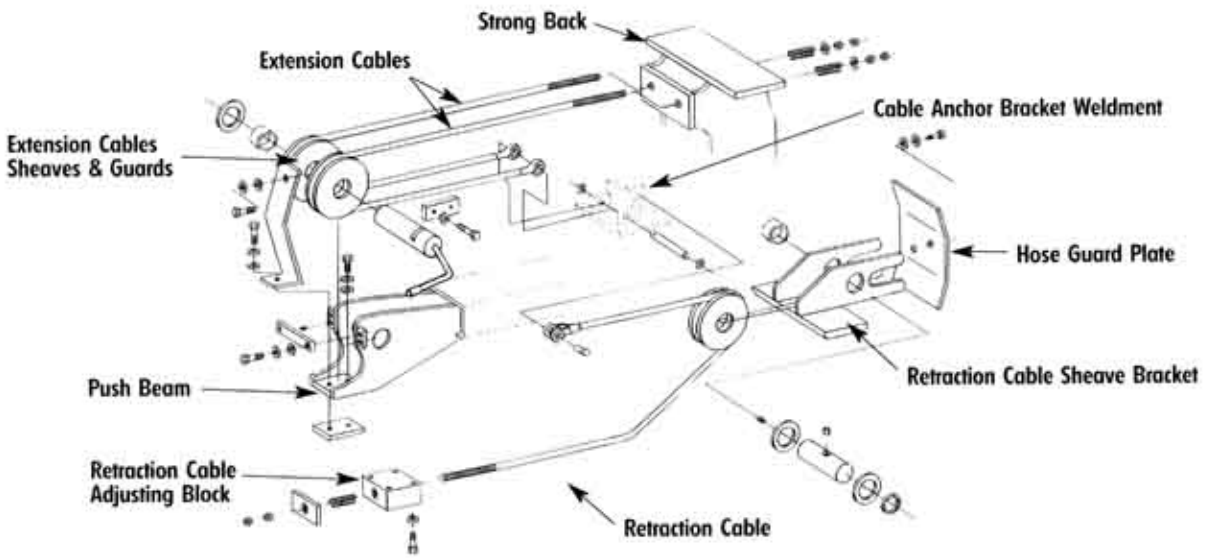
"Boom Cable Data" (see below) covers part numbers used, length, and key specifications. Please review this table to be certain you are using the correct cable for your operation. **Do Not** use cable other than that supplied by Gradall for replacement. These cables are specifically designed for Gradall Material Handlers.

General Cable Information

- Cables are pre-stretched; lengths cited below are after pre-stretching.
- Threaded stud, Galvanized Plating.
- Safe Lock Closed Socket Terminal used on Extension Cable.
- Safe Lock or Spelter Socket used on Retraction Cable.
- Boom Cable length tolerances: +0.5" -1.0".
- Use 2 wrenches when torqueing adjusting jam nuts. Use the flat on the threaded cable end to hold the cable straight, eliminating twist.

Boom Cable Data

Model	Boom Length	Boom Cable Part Number	Cable Length	Cable Diameter	Thread Size	Socket Style
Retraction Cable						
534C & D-10	45'	9113-3356	198 1/2"	1/2"	7/8 - 14	Open
534C-6	42'	9112-3147	191 1/2"	3/8"	3/4 - 10	Open
532C-6, 534D-6	36'	9112-2013	161 1/2"	3/8"	3/4 - 10	Open
534C & D-9 & 10	40'	9114-3027	177 1/2"	1/2"	7/8 - 14	Open
Extension Cable						
534C & D-10	45'	9114-3355	386"	9/16"	1" - 8	Closed
534C & D-9 & 10	40'	9114-3026	344"	9/16"	1" - 8	Closed
534C-6	42'	9112-3146	383"	1/2"	7/8 - 14	Closed
532C-6, 534D-6	36'	9112-3012	323"	1/2"	7/8 - 14	Closed

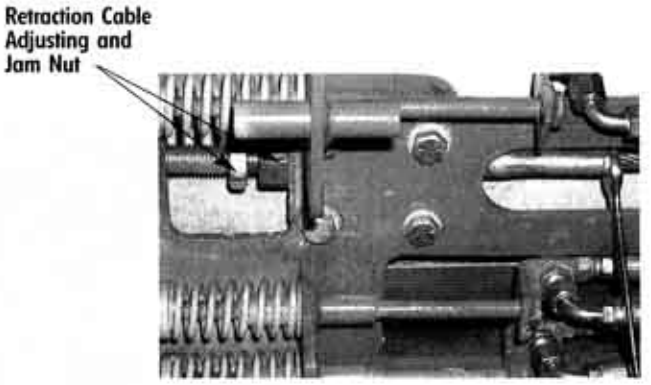


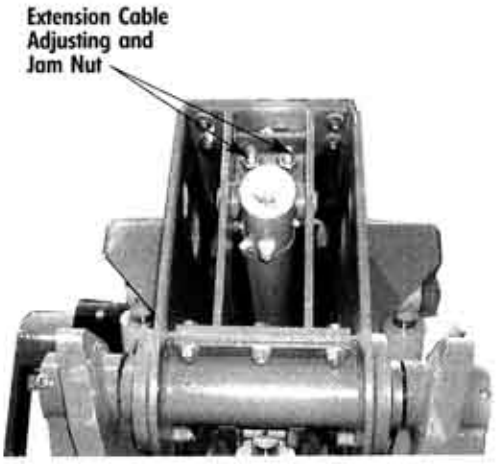
(7A) Cable Adjustments

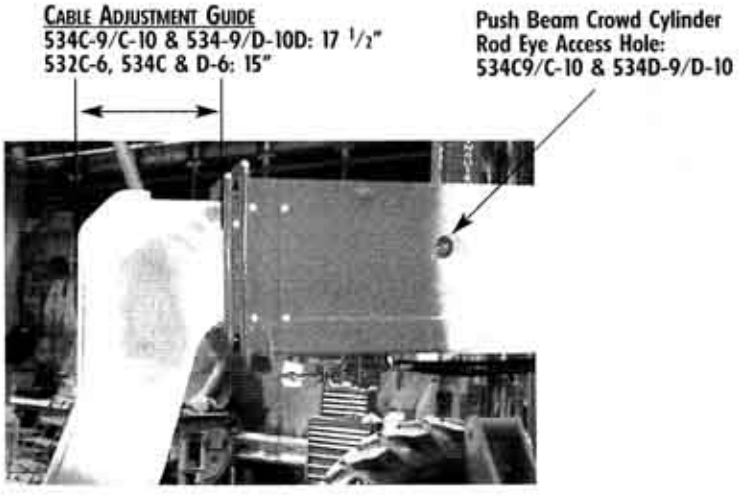
The cables are adjusted by tightening and/or backing off the adjusting nuts at the threaded end of the cable. Tightening the retraction cable adjusting nut pulls Boom-Section 3 in, to the rear. Tightening the extension cable adjusting nut pulls the boom out, to the front. The opposite cable adjusting nut usually must be loosened whenever this procedure is performed. The cables are properly adjusted whenever the following parameters are met:

534C9/C-10 & 534D-9/D-10:
Crowd cylinder rod eye pin is centered in the side access hole of the push beam and/or 17 1/2" dimension from Boom-Section 3 boom head front to the front of Boom-Section 2.

532C-6, 534C6 & 534D-6:
15" dimension from Boom-Section 3 boom head front to the front of Boom-Section 2.







(7B) Retraction Cable Removal

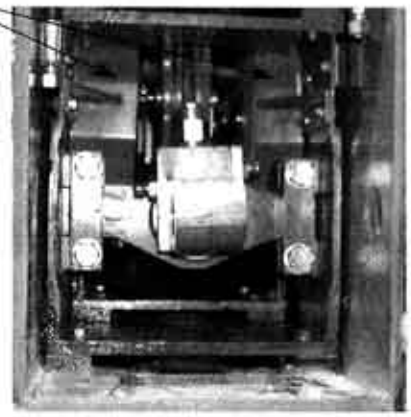
Removal of the retraction cable is a difficult operation; but it can be accomplished. You must be able to reach into the rear of the boom assembly to unfasten the retraction cable socket from the cable anchor bracket weldment. If you can't reach this bracket, the booms must be separated.

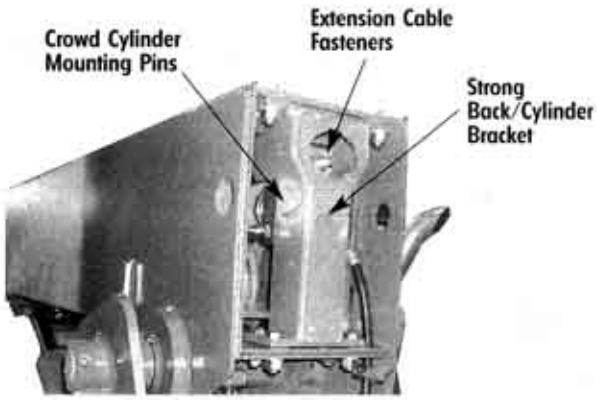
→ Preparation

- Retract the boom assembly fully.
- Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel. **DO NOT** reach into the boom until you are **CERTAIN** that keys have been removed from the ignition.
- Place the machine in a level, open area with sufficient space to work safely.
- Procure tools and platforms required for this operation.
- Procure a rope to tie to the cable end. This rope must be of sufficient length to allow accessibility whenever the cable is removed. This will assist in reinstallation.
- If working with a helper, be certain each of you know your individual assignments.

→ Stage 1

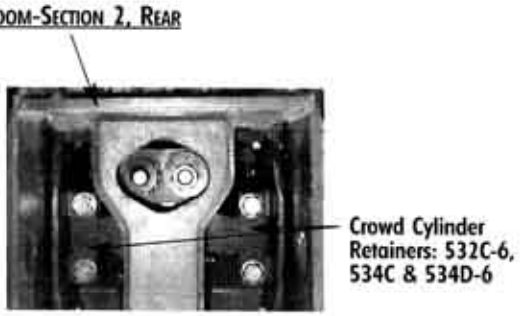
1. Remove the hose guards from the rear of Boom-Section 1.
2. Remove the crowd cylinder mounting pins from the strong back/cylinder bracket.
3. Remove the extension cable fastener hardware from the strong back/cylinder bracket.
4. Pull the cable free of strong back/cylinder bracket. Fasten a rope to the cable end to aid in reinstallation.
5. Remove the strong back/cylinder bracket mounting hardware.
6. Remove the strong back/cylinder bracket from the rear of the machine.

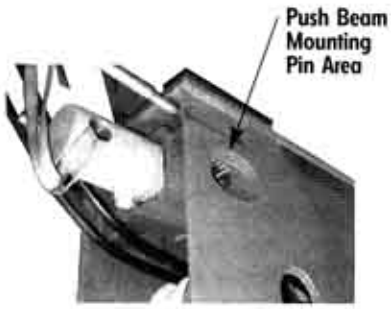




→ **Stage 2**

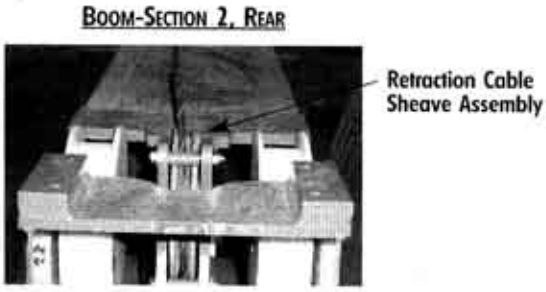
1. **534C & D-9 & 10:**
   Remove the push beam mounting pins.
2. At the front of Boom-Section 3, pull the push beam clear of Boom-Section 3.
3. Separate, plug and cap the crowd cylinder hoses.
4. **532C-6, 534C-6 & 534D-6:**
   At the rear of Boom-Section 2, remove the crowd cylinder retainers.
5. Drop the crowd cylinder to the bottom of the boom to give more clearance for access to the inside of the booms in the second section. The cylinder must be removed from the retainer area.

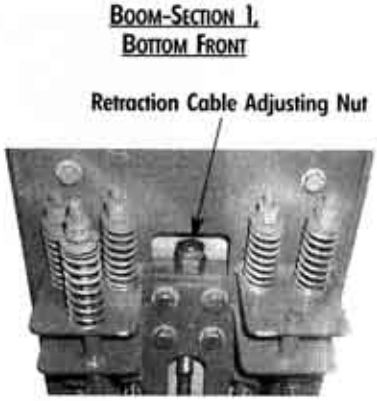




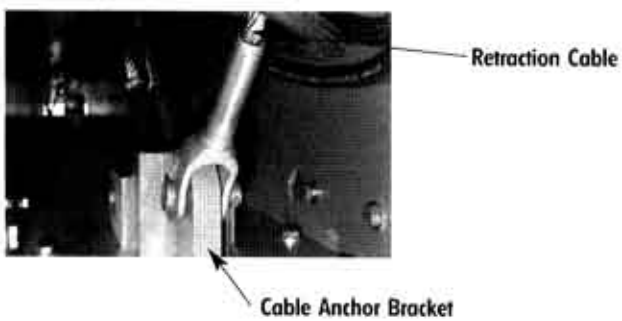
→ **Stage 3**

1. At the bottom front of Boom-Section 3, loosen the retraction cable adjustment fasteners.
2. Remove all the retraction cable sheave components.





3. Reaching inside the boom rear, at the cable anchor bracket weldment, remove the cotter pin from the retraction cable pin.
4. Remove the retraction cable pin. The retraction cable should now be free.
5. Pull the cable from the boom assembly through the rear. Remove the ropes, and leave them in place to aid in reinstallation.



(7C) Retraction Cable Reinstallation

To reinstall the retraction cable, you must be able to reach into the rear of the boom assembly to the cable anchor bracket weldment. The anchor bracket is welded to the bottom rear boom plate of Boom-Section 3. If you can't reach the bracket, the booms will have to be separated. Be certain that the keys have been removed from the ignition and fasten a "do not operate" tag to the steering wheel before you reach into the boom.

→ Preparation

- Place the machine in a level, open area with sufficient space to work safely.
- Procure the tools and platforms required for this operation.
- If working with a helper, review each of your duties.
- Be certain that the boom assembly is still retracted fully. If not, mechanically push the boom into the correct position before commencing reinstallation. **DO NOT** reach into the beam assembly while sections are being mechanically retracted/extended.

→ Stage 1

1. Fasten a rope to the retraction cable and pull the cable through the Boom-Sections to the approximate final position. Remove the rope.
2. Install the retraction cable socket end with mounting hardware to the cable anchor bracket weldment.

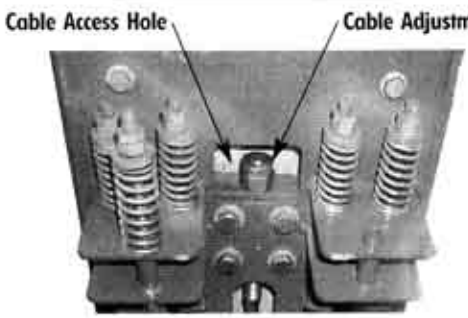
Cable Anchor Bracket

3. Install the retraction cable threaded end through the rear cable sheave bracket and cable adjusting block, bolted to the bottom front of Boom-Section 1.

Retraction Cable Sheave Assembly

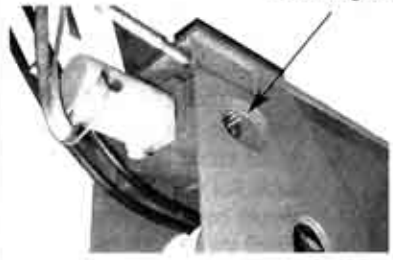
4. Feed the cable into the inside bottom front of Boom-Section 1 to the cable adjustment access hole.

Boom-Section 1, Bottom Front



5. **534C-9/C-10 & 534D-9/D-10:**
   At the front of Boom-Section 3, feed the push beam toward the rear of the boom assemblies to line up the push beam mounting pins.
6. Install the push beam mounting pins and fasteners.
7. **532C-6, 534C-6 & 534D-6:**
   Reinstall the crowd cylinder into the retainers at the rear of Boom-Section 2.
8. Reinstall and torque the crowd cylinder retainer fasteners.

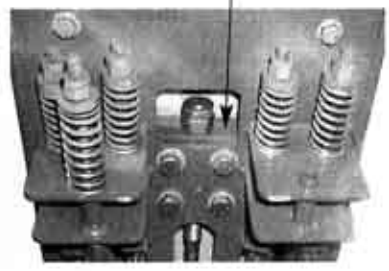
Push Beam Mounting Area



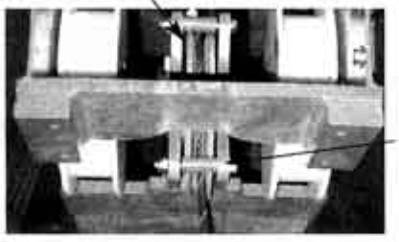
→ **Stage 2**

1. Install the retraction cable to the cable adjustment block at the bottom front of Boom-Section 1.
2. Install the retraction cable sheave and all the related components. Be certain the cable guards are installed.

Cable Adjustment Block



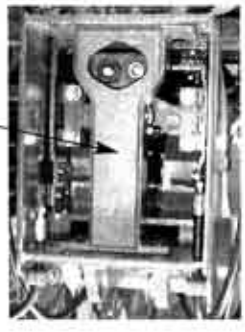
Retraction Cable Sheave



Cable Guard

3. Install the hose guards to the rear of the boom.
4. Place the strong back/cylinder bracket in place at the rear of Boom-Section 1.

Cylinder Bracket



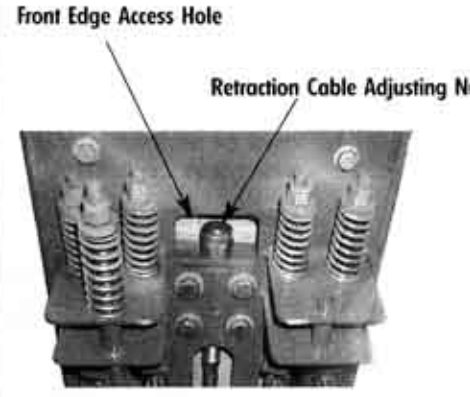
→ **Stage 3**

1. Install the crowd cylinder into the strong back/cylinder bracket.
2. Install previously removed shims to the top and bottom of the strong back/cylinder bracket.
3. Torque the strong back/cylinder bracket fasteners and apply ***LOCTITE* 242** to threads.
4. Reconnect the crowd cylinder hydraulic hoses.
5. Reinstall fasteners and springs to the extension cable threads at the strong back/cylinder bracket.

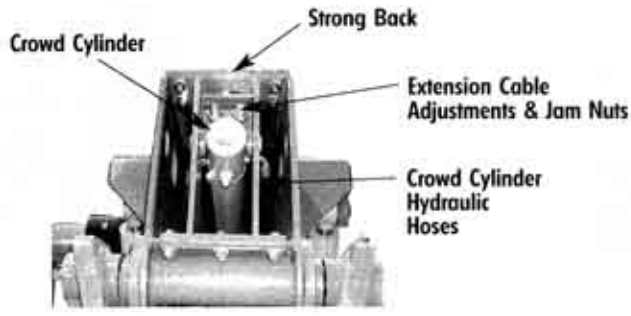
→ **Stage 4**

534C-9/C-10 & 534D-9/D-10 ONLY!

1. At the retraction cable adjusting block, located at the inside bottom front of Boom-Section 1, tighten the cable adjusting nut until the third thread lines up with the front edge of the access hole.
2. Install the jam nut to the adjusting nut and torque to 100 ft-lb.
3. At the strong back, tighten the extension cable adjusting nut until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the cable is not twisting.
4. Install the jam nut and torque to 100 ft-lb.
5. Adjust the cables to specifications given on page 7.1.



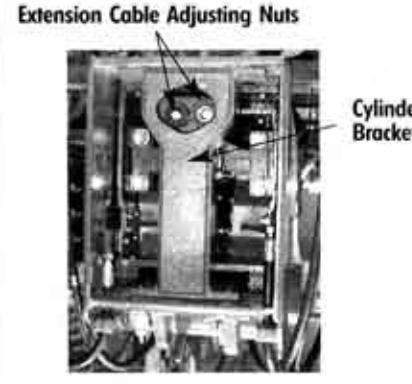
BOOM REAR 534C-9/C-10 & 534D-9/D-10



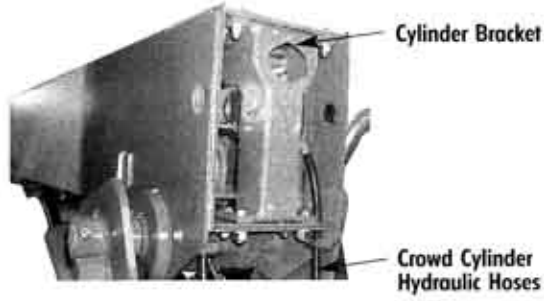
→ **Stage 4**

532C-6, 534C-6 & 534D-6 ONLY!

1. At the retraction cable adjusting block located at the inside front bottom of Boom-Section 1, tighten the cable adjusting nut until the front of the threaded end lines up with the front edge of the access hole.
2. Install the jam nut against the adjusting nut and torque to 100 ft-lb.
3. At the cable adjusting bracket, tighten the extension cable adjusting nuts until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the wire rope is not twisting.
4. Install the jam nut against the adjusting nuts and torque to 100 ft-lb.
5. Adjust the cables to specifications given on page 7.1.



532C-6, 534C-6 & 534D-6



The Retraction Cable should now be correctly installed.

(7D) Extension Cable Removal

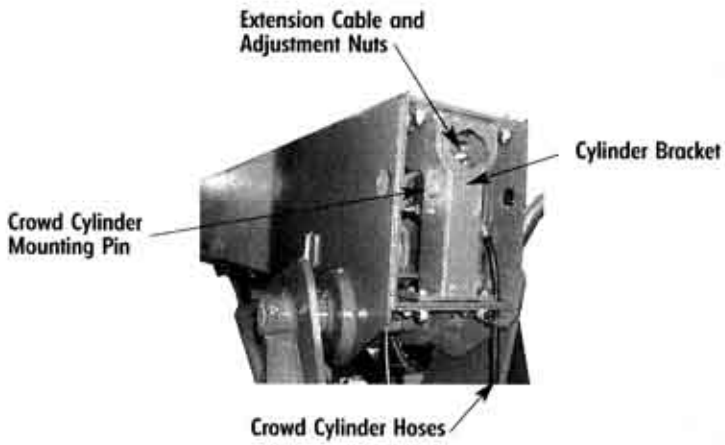
Removal of the extension cable is a difficult operation, but it can be accomplished. You must be able to reach into the rear of the boom assembly to unfasten the extension cable socket from the cable anchor bracket weldment. The bracket is welded to the rear bottom plate of Boom-Section 3. If you can't reach this bracket, the booms must be separated. Make sure that the keys have been removed from the ignition and fasten a "do not operate" tag to the steering wheel before you reach into the boom.

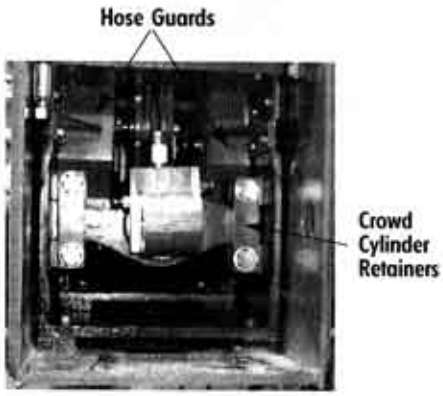
→ Preparation

- Retract the boom assembly fully.
- Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel. **DO NOT** reach into the boom until you are **CERTAIN** that keys have been removed from the ignition.
- Place the machine in a level, open area with sufficient space to work safely.
- Procure the tools and platforms required for this operation.
- Procure a rope to tie to the cable. This rope must be of sufficient length to allow access to each end whenever it is pulled through the boom assemblies with the cable.
- If working with a helper, review each of your duties.

→ Stage 1

1. Remove the hose guards from the rear of Boom-Section 1.
2. Separate, plug and cap the crowd cylinder hoses.
3. Remove the crowd cylinder mounting pins from the strong back/cable bracket.
4. Remove the extension cable mounting hardware from the strong back/cylinder bracket at the rear of boom.
5. Pull the cable free of the strong back/cylinder bracket. Fasten a rope to the cable end to aid in reinstallation.
6. Remove the strong back/cylinder bracket from the ear of the boom assembly. Keep the top and bottom shim packs together and identified. This will make assembly easier.

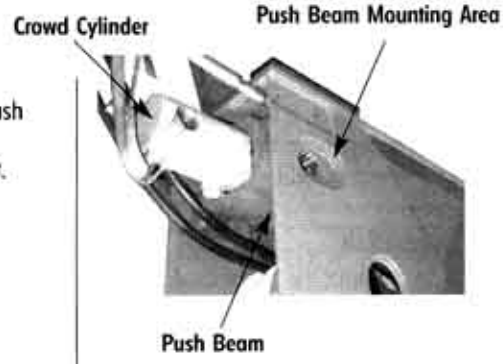




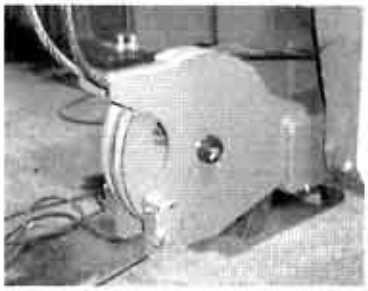
→ **Stage 2**

534C-9/C-10 & 534D-9/D-10 ONLY!

1. Remove the push beam mounting hardware.
2. Pull the push beam extension cable sheave bracket free of Boom-Section 3.
3. Remove all extension cable sheave bracket components from the front of the push beam.
4. Pull the extension cable through the push beam extension cable sheave bracket.



PUSH BEAM SHEAVE BRACKET

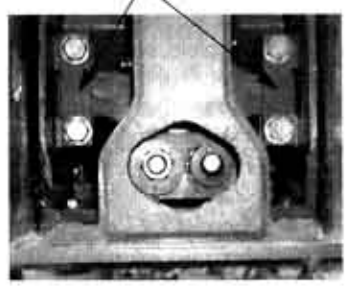


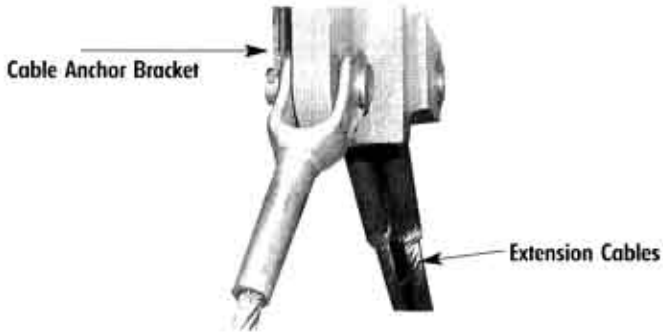
→ **Stage 2**

532C-6, 534C-6 & 534D-6 ONLY!

1. Remove the crowd cylinder retainers from the rear of Boom-Section 2.
2. Drop the crowd cylinder to the bottom of the boom. This will give more clearance for access to the cable anchor bracket welded to the bottom rear of Boom-Section 3.
3. At Boom-Section 3, front boom head, remove the extension cable sheave bracket assembly components. This will allow the passage of the threaded end of the cable through the sheave bracket.

Crowd Cylinder Retainers





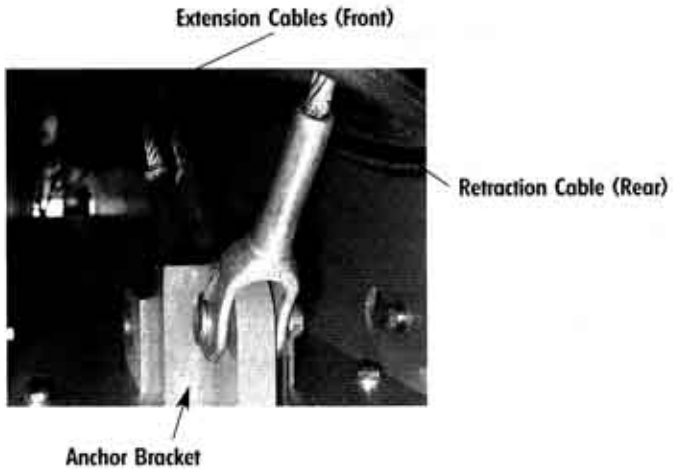
4. Pull the extension cable free of the sheave bracket.

EXTENSION CABLE SHEAVE BRACKET

→ **Stage 3**

532C-6, 534C-6 & 534D-6

1. If required for clearance access, pull the crowd cylinder free of the boom through the back of the boom assembly. To do this, you will have to remove the extension cable sheave bracket from the front of the crowd cylinder.
2. Reach inside the rear of Boom-Section 3, and remove the extension cable retaining ring (snap ring) and the extension cable pin. This pin is located at the front of the cable anchor bracket weldment which is welded to the bottom rear of Boom-Section 3.
3. The extension cable is now free and can be removed from the boom.
4. Tie a rope to the extension cable socket end to aid in reinstallation.



(7E) Extension Cable Reinstallation

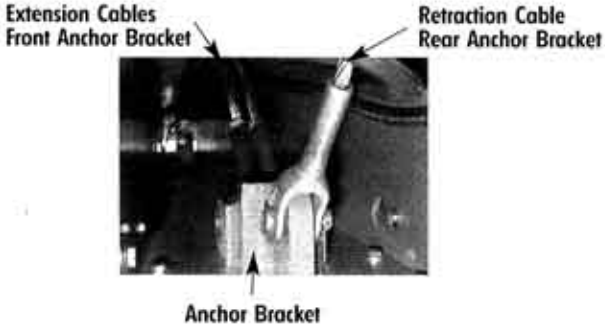
To reinstall the extension cable, you must be able to reach into the rear of the boom assembly to the cable anchor bracket weldment. The anchor bracket is welded to the bottom rear boom plate of Boom-Section 3. If you can't reach the bracket, the booms must be separated. Make sure the keys have been removed from the ignition and fasten a "do not operate" tag to the steering wheel before you reach into the boom.

→ Preparation

- Place the machine in a level, open area with sufficient space to work safely.
- Procure the tools and platforms required for this operation.
- If working with a helper, review each of your duties.
- Be certain the boom assembly is still retracted fully. If not, mechanically push the boom into the correct position. **DO NOT reach into the boom assembly while sections are being mechanically retracted/extended.**

→ Stage 1

1. Tie a rope to the extension cable threaded end and pull the cable to the anchor bracket weldment area.
2. Install the extension cable socket end and the mounting hardware to the cable anchor bracket weldment.

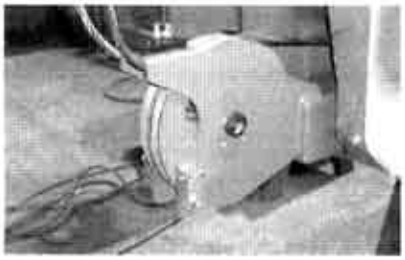


3. **532C-6, 534C-6 & 536D-6:**
   If it has been removed, install the crowd cylinder into the boom assembly from the rear.
4. If it has been removed, install the extension cable sheave bracket to the front of the crowd cylinder.

532C-6, 534C-6 & 534D-6
Extension Cable Sheave Bracket

5. Install the extension cable threaded end through the sheave bracket and feed to the rear of the boom.
6. **534C-9/C10 & 534D-9/D-10:**
   Assemble all extension cable sheave bracket components to the front of the push beam. Be certain that the cable threaded end is inserted through the sheave bracket before the sheave components are installed.

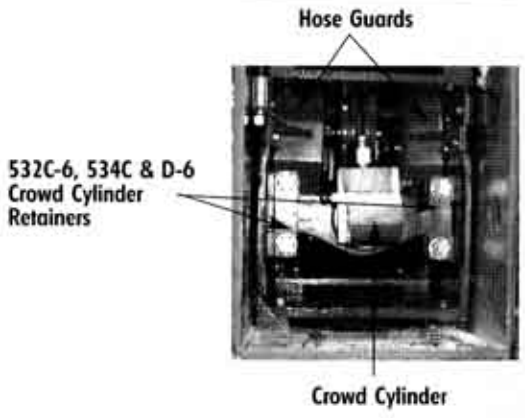
534C-9/C-10 & 534D-9/D-10
Push Beam Front,
Extension Cable Sheave Bracket



→ **Stage 2**

1. **534C-9/C-10 & 534D-9/D-10:**
   Insert the push beam fully into Boom-Section 2.
2. **532C-6, 534C-6 & 534D-6:**
   Insert the crowd cylinder fully into Boom-Section 2.

532C-6, 534C-6 & 534D-6

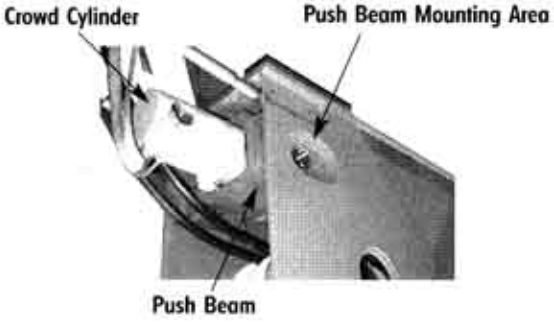


3. Install the push beam mounting hardware or crowd cylinder retainers.
4. Install the tilt and auxiliary circuit hose guards at the rear of Boom-Section 1.

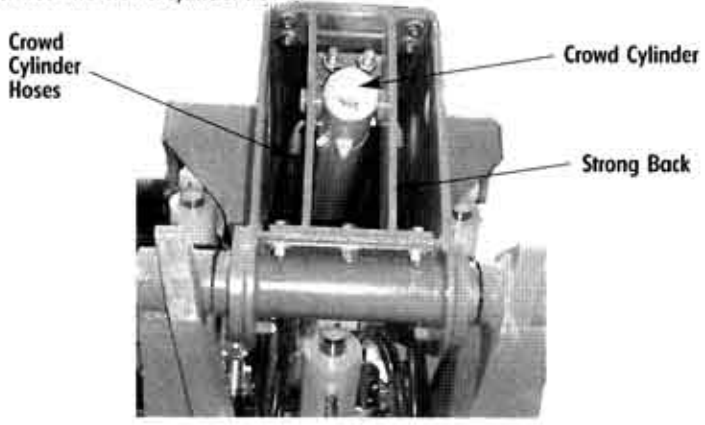
→ **Stage 3**

1. Place the strong back/cable bracket in place at the rear of Boom-Section 1.

534C/C-10 & 534D-9/D-10



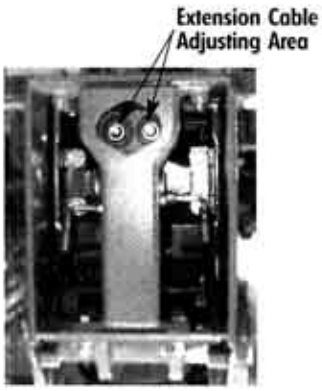
2. Install the crowd cylinder and mounting hardware into the strong back/cable bracket.
3. Replace the removed shim packs to the strong back/cable bracket.
4. Install and torque the strong back/cable bracket fasteners by applying ***LOCTITE* 242** to threads.
5. Reconnect the crowd cylinder hoses.



→ **Stage 4**

1. Feed the extension cables into the strong back/cable bracket mounting area. Be certain that the cables are stress-free and not twisted. Remove the rope.
2. Install the cable adjusting hardware. Tighten the extension cables' adjusting nuts until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the wire rope is not turning.

532C-6, 534C-6 & 534D-6
CYLINDER BRACKET



534C-9/C-10 & 534D-9/D-10
STRONG BACK

3. Install the jam nut against the adjusting nut and torque to 100 ft-lb. Make sure that the cable is not twisting.
4. Adjust the boom cables to the parameters given on page 7.1.

The Extension Cable is now installed.

Hydraulic hoses are used to carry fluid to the tilt cylinder and/or auxiliary circuits. At the boom, the hoses are fastened to the hose take-up weldment at the front outside/inside bottom of Boom-Section 1. They are then fed around a roller, through a protective channel at the top left and right of Boom-Section 3, to the front head of Boom-Section 3. At that point, another connection is made to carry fluid to the tilt or auxiliary circuit. Tilt circuit hoses are fed through the left side of the boom. Auxiliary circuit hoses are fed through the right side of the boom.

Hoses must be of correct length, laying straight and flat, rolling free of twist and torqued per values in "Appendix B". **LOCTITE 545** (Gradall P/N 1440-4043) must be used on all connections. Two wrenches should be used when tightening hoses to prevent twisting. Use one wrench on the swivel hose fitting; the other on the fixed hose fitting.

Gradall strongly recommends against using generic hoses as replacements. Hoses for Gradall Material Handlers are specifically designed for use in this application. There is no way to ensure that generic hoses will meet Gradall's strict application performance requirements.

TILT AND AUXILIARY CIRCUIT HOSE REMOVAL/REINSTALLATION

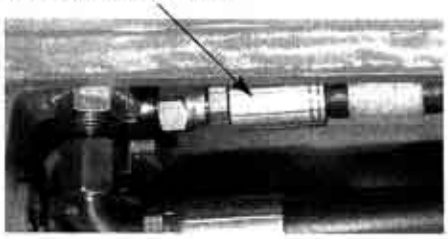
Hoses normally can be removed and reinstalled simply by connecting a union to the fittings on the hose (joining them together) then pulling them through the boom assembly until they are free. You may have to remove the hose guard at the roller assembly. If this doesn't work, follow the procedures listed below.

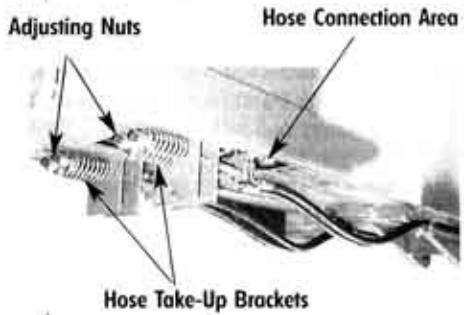
→ Preparation

- Retract the boom fully level.
- Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel.
- Procure the tools and work platforms to allow the work to progress safely.
- Procure a rope to assist pulling the hose to the correct location during reinstall.
- If working with a helper, be certain each of you know your assigned duties.
- Review the removal/reinstallation procedure.

→ Removal, Stage 1

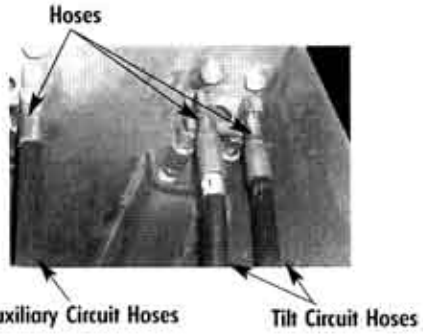
1. Loosen the adjusting nuts at the hose take-up bracket to relieve the tension on the hose assemblies.
2. At the inside of the hose take-up brackets, separate, plug, and cap all hoses to be removed.

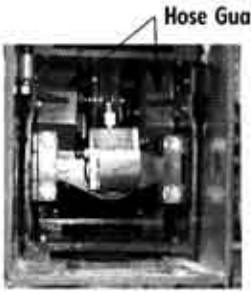




→ Removal, Stage 2

1. At the rear of the boom, remove the hose guard for the hose being removed.
2. At the front of Boom-Section 3, separate, cap, and plug the hose to be removed. Tie a rope to the hose end.
3. Through the rear, pull the separated hose free of the boom assembly.
4. At the hose take-up bracket area, pull the hose free of the boom assembly.

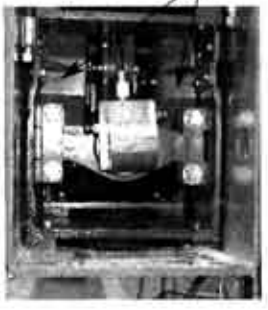




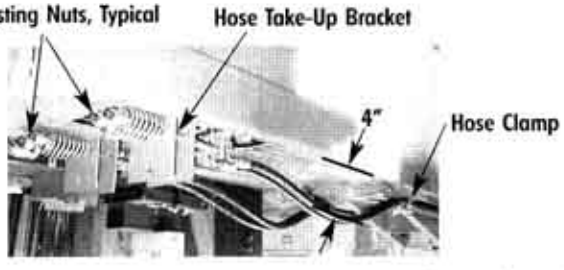
→ Reinstallation

1. Tie the rope to the hose end.
2. Installing the hose at the hose bracket take-up area, pull the hose to the rear of the boom.

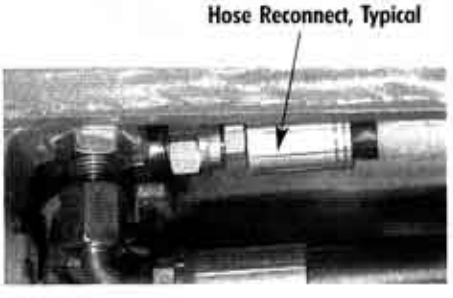
Steps 1 & 3



3. Feed the hose around the roller and pull it through the protective channels in Boom-Section 3 to the boom head at the front.
4. At the boom head, apply LOCTITE 545 to the fittings, connect and torque the hoses and install clamps.
5. Install the hose guard at the rear boom roller.
6. Apply LOCTITE 545 to the hose fittings at the hose take-up bracket area; connect and torque the hose.



7. Tighten the hose take-up bracket adjusting nuts. Ensure 4" dimension (boom bottom to hose) is held at the hose area between the take-up bracket and the first hose clamp.



The Hose is now correctly installed.

ELECTRIC BOOM CABLE

The electric cable is fed through the right side of the boom assembly in a fashion similar to the auxiliary hydraulic hoses. The electric cable lies adjacent to the hydraulic hoses and moves in unison with them, whenever the booms are extended and retracted. The receptacle and socket connector are equipped with a strain relief fitting to prevent wires from pulling loose. This strain relief is tie-wrapped to the cable. **DO NOT** install a cable without the strain relief connected.

The socket end of the electric cable is fastened to the front boom head of Boom-Section 3. It is secured with a bracket at this location. A strain relief fitting is installed at the cable take-up weldment and support. These assemblies are located in the area adjacent to the hydraulic hose take-up weldment.

The receptical and socket are equipped with six contact points. One contact point is usually extra and is plugged using Gradall Part No. 8348-1301. Refer to the following chart for identification in the socket (as viewed from the wire insertion end).

ELECTRICAL WIRE DATA

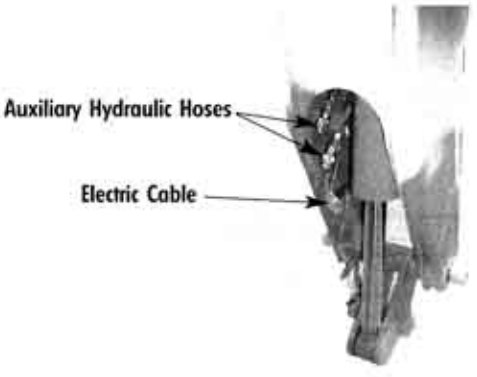
Socket Body Letter	Wire Color	Wire Function
"TM"	Orange	Panel
"A"	Blue	Open/Extra
"S"	Black	Mast
"RT"	Green	Swing
"LT"	Red	Side Shift
"C"	Green/Yellow	Ground

Electric Cable Removal

→ **Stage 1**

1. Retract the boom fully level.
2. At the front of Boom-Section 3 boom head, unfasten the electrical socket and clamps.
3. Remove the socket from the electrical cable.
4. Remove the strain relief fitting and the tube at the boom head from the boom and cable.
5. Tie a rope to the cable end; this will aid in reinstallation.

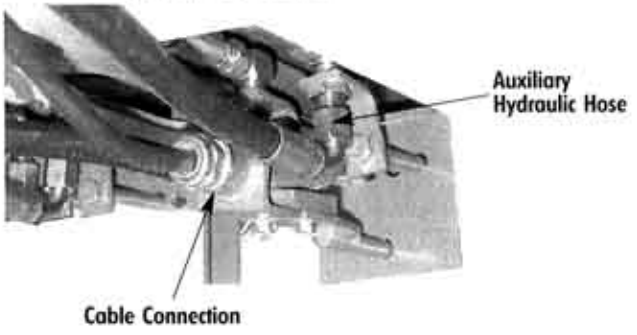
Boom Head



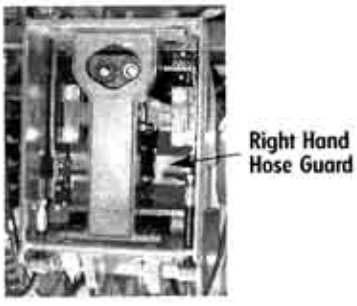
→ **Stage 2**

1. At the rear of the boom, remove the hose guard from the right side roller.
2. Pull the electric cable to the rear, free of the boom assembly.
3. At the bottom front of Boom-Section 1, remove the cable take-up weldment and support.
4. Pull the electric cable free of the boom through the cable take-up weldment.
5. Remove the remaining cable clamps and unplug the receptacle.

Boom-Section 1, Bottom Front, Cable Take-Up Bracket



Rear View Boom Assembly



The Electric Cable is now free of the Boom assembly.

Electric Cable Installation

It is assumed the electric cable has been removed and related parts are still left off the boom assembly. The electric socket must not be installed at this time. The cable must be well tensioned in the area between the strain reliefs at the boom head and Boom-Section cable take-up brackets.

→ Stage 1

1. Tie the rope to the cable and feed it through the strain relief fitting and cable take-up weldment tube, then feed to the rear through the cable take-up weldment located at the bottom front of Boom-Section 1. The cable lies in the bottom plate area between Boom-Sections 1 and 2.
2. Feed electric cable around right side hose roller, through top protection channel, then to the boom head at the front of Boom-Section 3.
3. Install the hose guard at right side hose roller located at the rear of Boom-Section 2.

Boom Head

→ Stage 2

1. At front boom head of Boom-Section 3, feed the cable through the tube weldment, and install the strain relief fittings on cable. Do not tighten at this time.
2. Pull the electric cable through the boom to correct position at boom head
3. Install cable wires into the socket. See "Electrical Wire Data" on page 9.0 for wire locations.
4. Install the socket into the bracket at the boom head. Tighten the strain relief fitting at the socket and tube. Install and tighten the cable clamps at the boom head.

→ Stage 3

1. Install the cable take-up weldment and support at the bottom front of Boom-Section 1.
2. Tighten the strain relief fittings at the cable take-up weldment area.
3. Install the cable clamps to the bottom front of Boom-Section 1.
4. Plug the receptacle connector into the frame cable wiring harness.

Front Bottom Boom Section 1
Cable Take-Up Bracket

The Electric Cable is now correctly installed.

10.0 Crowd Cylinder Removal and Installation

The crowd cylinder hydraulically extends and retracts Boom-Section 2. A cable sheave arrangement is designed into the system to extend and retract Boom-Section 3 proportional to Boom-Section 2. While similar in operation, there are slight differences in cylinder design for 532C-6, 534C-6 & 534D-6 machines verses 534C-9/C-10 & 534D-9/D-10 machines.

The 534C-9/C-10 & 534D-9/D-10 cylinder is installed in a push beam. The base end of the cylinder mounts into a structure at the rear of Boom-Section 1 called a strong back. The rod eye end of the cylinder mounts into the push beam. The push beam is fastened to the rear of Boom-Section 2. As the cylinder rod extends or retracts, the push beam moves Boom-Section 2 proportional.

The 532C-6 and 534C-6 & 534D-6 cylinder rod end is fastened to a cable bracket mounted to the rear of Boom-Section 1 (similar to the strong back of the 534C-9/C-10 & 534D-9/D-10). The rear of the cylinder barrel is designed with a mount that fits into a retainer bracket at the rear of Boom-Section 2. The front of the cylinder barrel is equipped with mounting bolts to hold the cable sheave assembly. As the cylinder rod extends and retracts the barrel movement moves Boom-Section 2 proportional.

Re-pack kits for the crowd cylinders are available from your Authorized Gradall Distributor.

Removing and Reinstalling the Crowd Cylinder:

534C-9/C-10 & 534D-9/D-1 ONLY!

→ **Preparation**

- Review all safety issues before commencing work.
- Place the machine in a safe, level, uncongested working area.
- Apply the brakes and chock the wheels.
- Procure a crane and lifting tackle capable of lifting 1000 lb.
- If working with a helper, be certain each of you know your assigned duties.
- Select a location to place the cylinder once it has been removed.
- Pressure-wash or steam-clean the machine so that you have a clean safe working surface.

→ **Removal**

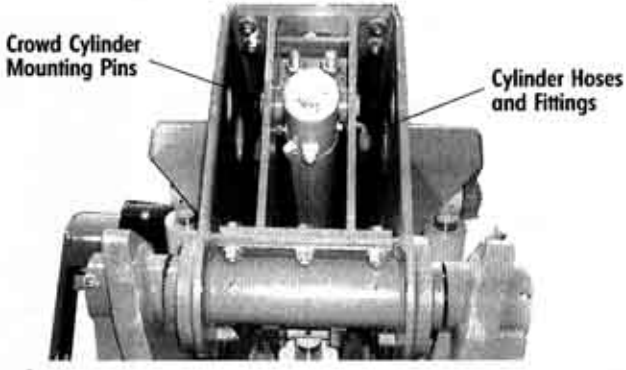
1. Retract the boom and line up the push beam crowd cylinder rod eye access holes in all Boom-Sections.
2. Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the cylinder rod eye mounting pin.
4. Separate, plug and cap the crowd cylinder hoses at the rear of the boom assembly.
5. Remove the crowd cylinder fittings from the rear of the cylinder barrel.
6. Attach lifting tackle to the cylinder, remove the mounting pins and carefully pull the crowd cylinder free of the machine through the strong back.
7. Place the crowd cylinder in the designated area for the next operation.

→ **Reinstallation:**

1. Feed the crowd cylinder into the push beam and line up the rod eye to the access holes. Be certain that the bearing pad is installed at the rod end of the cylinder.
2. Install the rod eye mounting pin and secure.

3. Install the crowd cylinder base mounting pin into the strong back and secure.

REAR BOOM ASSEMBLY STRONG BACK



4. Apply **LOCTITE 545** (Gradall P/N 1440-4043) to cylinder fittings and install into the barrel.
5. Apply **LOCTITE 545** to fittings and reconnect the hydraulic hoses.

The Crowd Cylinder is now installed.

Removing and Reinstalling the Crowd Cylinder:
532C-6 & 534C-6 & 534D-6 ONLY!

→ Preparation

- Review all safety issues before commencing work.
- Place the machine in a safe, level, uncongested working area.
- Apply the brakes and chock the wheels.
- Procure a crane and lifting tackle capable of lifting 1000 lb.
- If working with a helper, be certain each of you knows your assigned duties.
- Select a location to place the cylinder once it has been removed.
- Pressure-wash or steam-clean the machine so that you have a clean safe working surface.

→ Removal

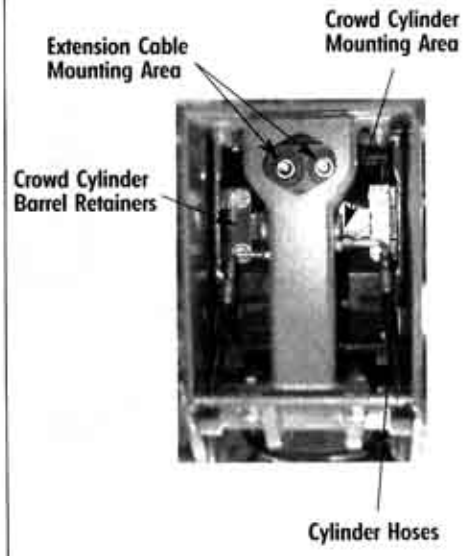
1. Level and retract the boom within approximately 1 ft. of full retraction. The boom sections should be positioned to allow the top rear cable access holes to line up.
2. Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the extension cable adjusting hardware from the rear cable bracket. Reaching through the top rear access hole, install a wrench to cable end flat. This will keep the cable from twisting during removal.
4. At the boom head of Boom-Section 3, remove the four extension cable sheave bracket mounting nuts.
5. At the boom rear cable bracket, remove the crowd cylinder mounting pins and hardware.
6. Remove the cable bracket from Boom-Section 1. Identify top and bottom shim packs to aid in reinstallation.
7. Disconnect the hydraulic hoses from the crowd cylinder.
8. Fasten lifting tackle to the crowd cylinder and take the weight off the cylinder.
9. Remove the crowd cylinder retainers from the rear of Boom-Section 2.
10. Through the back of the boom, carefully pull the crowd cylinder free.
11. Pull the extension cables free of the boom while extracting the crowd cylinder. Keep tension against the sheave bracket. This will pull the sheave bracket toward the rear to the inside cable anchor bracket.
12. Place the crowd cylinder in the designated area for the next operation.

→ Reinstallation

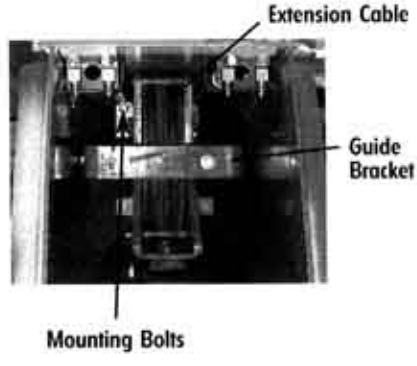
1. Lift and feed the cylinder into the boom assembly, through the rear.
2. Carefully install the cylinder into the extension cable sheave assembly bracket. The sheave bracket will be located at the cable anchor bracket area, inside Boom-Section 3. Be careful not to damage the sheave bracket mounting bolts while installing the cylinder into the bracket.
3. Keep tension on the extension cable sheave while the crowd cylinder is being fully inserted.
4. Install the crowd cylinder retainers at the rear of Boom-Section 2 rear. Apply **LOCTITE 242** (Gradall P/N 1440-3364) to the threads and torque as required.
5. Place the cylinder bracket in place at the rear of Boom-Section 1.
6. Install the crowd cylinder mounting pins into the cylinder bracket.
7. Install and torque the cylinder bracket fasteners. Use **LOCTITE 242** on the threads.
8. Apply **LOCTITE 545** (Gradall P/N 1440-4043) to the hydraulic fittings and reconnect the crowd cylinder hoses.
9. Reinstall the extension cables and the hardware. Adjust as required.

The Crowd Cylinder is now installed.

Cylinder Bracket - Rear



Boom Head, Front Extension Cable Sheave Bracket (Hoses removed for clarity)



Appendix A: Fastener Torque Chart

The following bolt torque charts covering English and Metric fasteners are the ones used by Gradall Engineering. Gradall ratings are for lubricated fasteners. Do not exceed the allowable rating. **Remember!** An over-torqued bolt in most cases will fail as rapidly as an under-torqued one.

Lubricated English Bolts

BOLT SIZE	GRADE 5 BOLTS			GRADE 8 BOLTS		
	Torque (ft-lb.)	Tolerance + or - (ft-lb.)	Clamp Load (lb.)	Torque + or - (ft-lb.)	Tolerance + or - (ft-lb.)	Clamp Load (lb.)
1/4 - 20	9	+3 -0	2,700	10	+3 -0	3,000
1/4 - 28	11	+3 -0	3,300	12	+3 -0	3,600
5/16 - 18	17	+5 -0	4,080	20	+5 -0	4,800
5/16 - 24	19	+5 -0	4,560	24	+5 -0	5,760
3/8 - 16	30	+5 -0	6,000	40	+5 -0	8,000
3/8 - 24	32	+5 -0	6,400	48	+5 -0	9,600
7/16 - 14	44	+10 -0	7,540	68	+10 -0	11,660
7/16 - 20	48	+10 -0	8,230	76	+10 -0	13,030
1/2 - 13	68	+10 -0	10,200	100	+10 -0	15,000
1/2 - 20	76	+10 -0	11,400	115	+10 -0	17,250
9/16 - 12	100	+10 -0	13,330	140	+10 -0	18,670
9/16 - 18	112	+10 -0	14,930	160	+10 -0	21,330
5/8 - 11	140	+15 -0	16,800	200	+15 -0	24,000
5/8 - 18	168	+15 -0	20,160	215	+15 -0	25,800
3/4 - 10	240	+25 -0	24,000	340	+25 -0	34,000
3/4 - 16	265	+25 -0	26,500	370	+25 -0	37,000
7/8 - 9	360	+35 -0	30,860	530	+35 -0	45,430
7/8 - 14	390	+35 -0	33,430	560	+35 -0	48,000
1 - 8	545	+50 -0	40,875	795	+50 -0	59,625
1 - 14	570	+50 -0	42,750	840	+50 -0	63,000
1 1/8 - 7	710	+50 -0	47,330	1175	+50 -0	78,330
1 1/8 - 12	795	+50 -0	53,000	1325	+50 -0	88,330
1 1/4 - 7	1005	+75 -0	60,300	1680	+75 -0	100,800
1 1/4 - 12	1105	+75 -0	66,300	1850	+75 -0	111,000
3/8 - 6	1310	+75 -0	71,450	2200	+75 -0	120,000
1 3/8 - 12	1500	+75 -0	81,820	2490	+75 -0	135,820
1 1/2 - 6	1745	+75 -0	87,250	2910	+75 -0	145,500
1 1/2 - 12	1945	+75 -0	97,250	3280	+75 -0	164,000

Appendix A: Fastener Torque Chart

Metric Fasteners

Nominal Size	Stress Area (mm^2)	CLASS 4.6		CLASS 8.8		CLASS 9.8		CLASS 10.9		CLASS 12.9	
		400 Megapascals Min. Tensile Str.		830 Megapascals Min. Tensile Str.		900 Megapascals Min. Tensile Str.		1040 Megapascals Min. Tensile Str.		1220 Megapascals Min. Tensile Str.	
		(Nm)	(ft-lb.)	(Nm)	(ft-lb.)	(Nm)	(ft-lb.)	(Nm)	(ft-lb.)	(Nm)	(ft-lb.)
M 2.0	2.1	0.14	0.10	0.37	0.27	0.40	0.30	0.52	0.38	0.61	0.45
M 2.5	3.4	0.28	0.21	0.76	0.56	0.82	0.61	1.06	0.78	1.24	0.92
M 3.0	5.0	0.51	0.37	1.35	1.00	1.47	1.08	1.88	1.39	2.21	1.63
M 3.5	6.8	0.80	0.59	2.13	1.57	2.31	1.70	2.96	2.18	3.47	2.56
M 4.0	8.8	1.18	0.87	3.15	2.32	3.41	2.52	4.38	3.23	5.14	3.79
M 5.0	14.2	2.39	1.76	6.36	4.69	6.90	5.09	8.86	6.54	10.59	7.67
M 6.0	20.1	4.05	2.99	10.81	7.97	11.72	8.65	15.05	11.10	17.66	13.02
M 6.3	22.6	4.78	3.53	12.76	9.41	13.84	10.21	17.77	13.11	20.84	15.37
M 8.0	36.6	9.84	7.26	26.25	19.36	28.46	20.99	36.54	26.95	42.87	31.62
M 10.0	58.0	19.49	14.37	51.99	38.35	56.38	41.58	72.38	53.39	84.91	62.63
M 12.0	84.3	33.99	25.07	90.68	66.88	98.33	72.52	126.25	93.12	148.10	109.23
M 14.0	115.0	54.10	39.90	144.32	106.45	156.49	115.42	200.93	148.20	235.70	173.85
M 16.0	157.0	84.40	62.25	255.18	166.08	244.17	180.09	313.50	231.22	367.76	271.24
M 20.0	245.0	164.64	121.43	439.24	323.96	476.28	351.29	611.52	451.03	717.36	529.10
M 24.0	353.0	284.66	209.95	759.43	560.13	823.48	607.37	1057.31	779.83	1240.30	914.80
M 30.0	561.0	565.49	417.08	1508.64	1112.72	1635.88	1206.56	2100.38	1549.16	2463.91	1817.29
M 36.0	817.0	988.24	728.89	2636.49	1944.58	2858.85	2108.58	3670.62	2707.31	4305.92	3175.88
M 42.0	1120.0	1580.54	1165.75	4216.66	3110.05	4572.29	3372.35	5870.59	4329.93	6886.66	5079.34

Note!

To check Gradall torque values, set the torque wrench at 95% of rated torque value and check the fastener. If the torque wrench releases before the fastener moves, assume that fastener torque is correct. When setting Gradall torque values, use values given on the chart, not exceeding allowances.

CODE 61 4-BOLT SPLIT FLANGE BOLT TORQUE

SAE DASH SIZE	FLANGE SIZE	BOLT SIZE	BOLT TORQUE ft-lb.
-12	3/4	3/8-16	25+/-4.5
-16	1	3/8-16	31+/-4.5
-20	1 1/4	7/16-14	41+/-5
-24	1 1/2	1/2-13	52+/-6
-32	2	1/2-13	60+/-6

CODE 62 4-BOLT SPLIT FLANGE BOLT TORQUE

SAE DASH SIZE	FLANGE SIZE	BOLT SIZE	BOLT TORQUE ft-lb.
-12	3/4	3/8-16	30+/-4.5
-16	1	7/16-14	46+/-4.5
-20	1 1/4	1/2-13	69+/-6
-24	1 1/2	5/8-11	125+/-8

ORS FACE SEAL; TUBE/HOSE TO FITTING

SAE DASH SIZE	THREAD SIZE	TUBE SIDE ASSEMBLY TORQUE ft-lb.
-4	9/16-18	18+/-1
-6	11/16-16	27+/-2
-8	13/16-16	40+/-2
-10	1-14	63+/-3
-12	1 3/16-12	90+/-4
-16	1 7/16-12	120+/-8
-20	1 11/16-12	140+/-8
-24	2 1/2-12	165+/-8

Note!

Aluminum material ports use 50% of the steel torque value.

SAE FITTINGS; STRAIGHT & ADJUSTABLE

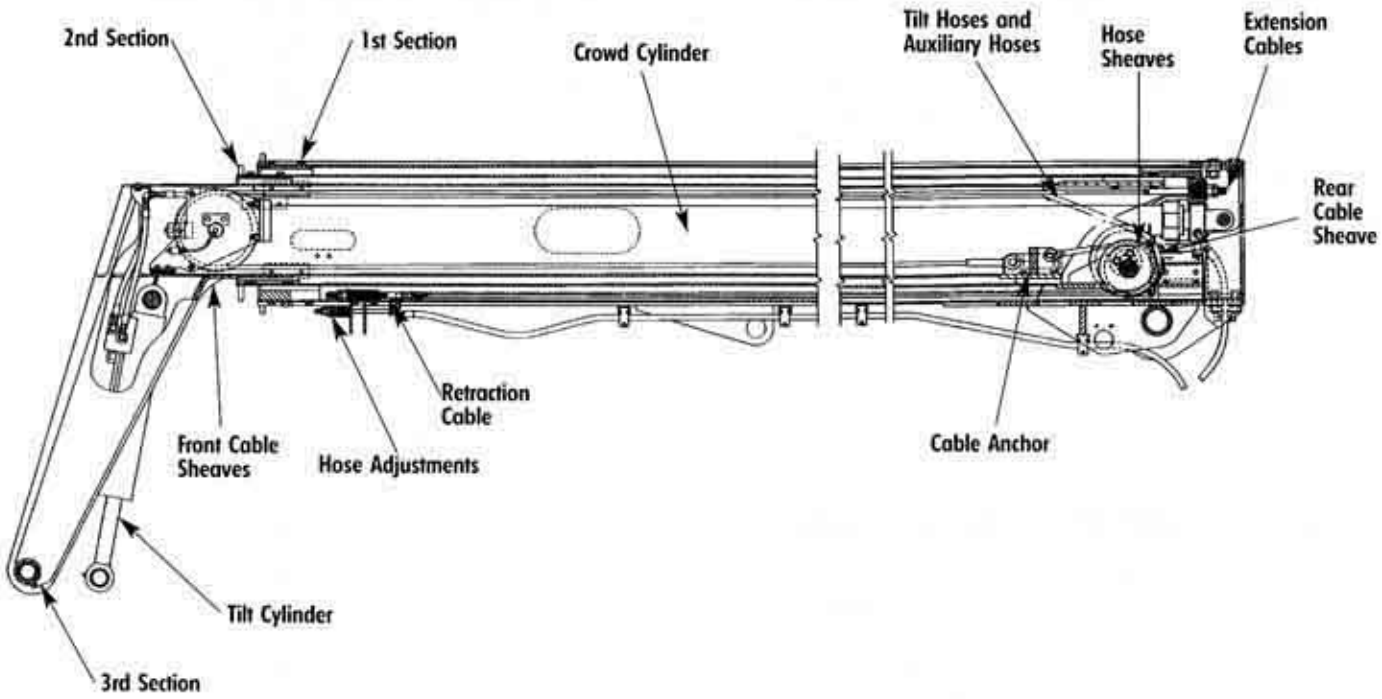
SAE DASH SIZE	THREAD SIZE	PORT SIDE ASSEMBLY TORQUE ft-lb.
-2	5/16-24	7.5+/-.5*
-3	3/8-24	14+/-1*
-4	7/16-20	16+/-1
-5	1/2-20	22+/-1*
-6	9/16-18	35+/-1
-8	3/4-16	60+/-2
-10	7/8-14	105+/-5
-12	1 1/16-12	140+/-6
-14	1 3/16-12	145+/-6*
-16	1 5/16-12	210+/-8
-20	1 5/8-12	260+/-12
-24	1 7/8-12	315+/-12
-32	2 1/2-12	325+/-15*

* TORQUE VALUES WITH AN ASTERISK ARE FROM JIC FITTING TORQUE CHART

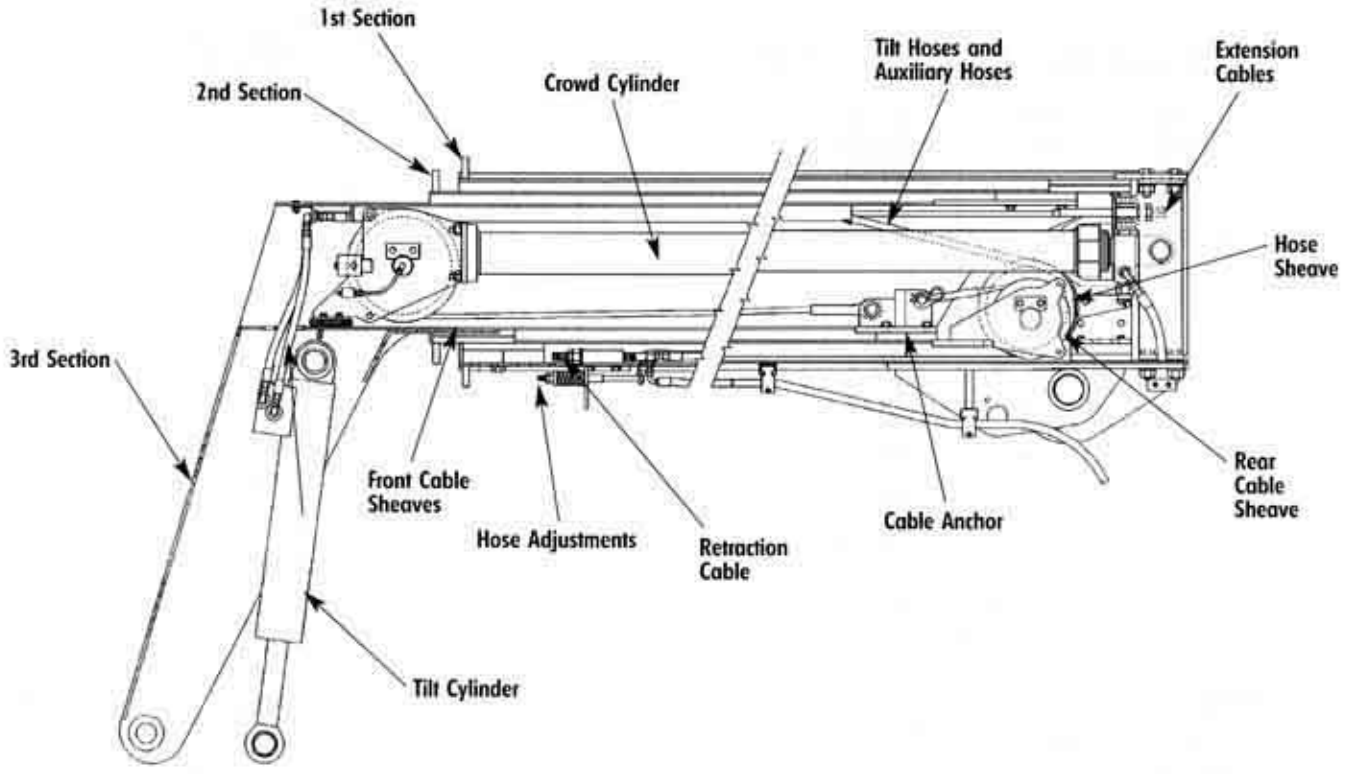
JIC 37° TUBE/HOSE TO FITTING

SAE DASH SIZE	THREAD SIZE	TUBE SIDE ASSEMBLY TORQUE ft-lb.
-2	5/16-24	3+/-1
-3	3/8-24	6+/-1
-4	7/16-20	12+/-1
-5	1/2-20	15+/-1
-6	9/16-18	21+/-1
-8	3/4-16	45+/-2
-10	7/8-14	60+/-5
-12	1 1/16-12	85+/-5
-14	1 5/16-12	105+/-5
-16	1 5/16-12	120+/-5
-20	1 5/8-12	170+/-10
-24	1 7/8-12	200+/-15
-32	2 1/2-12	270+/-20

APPENDIX C: 534C-6 AND D-6



APPENDIX C: 534C-9/C-10 AND 534D-9/D-10



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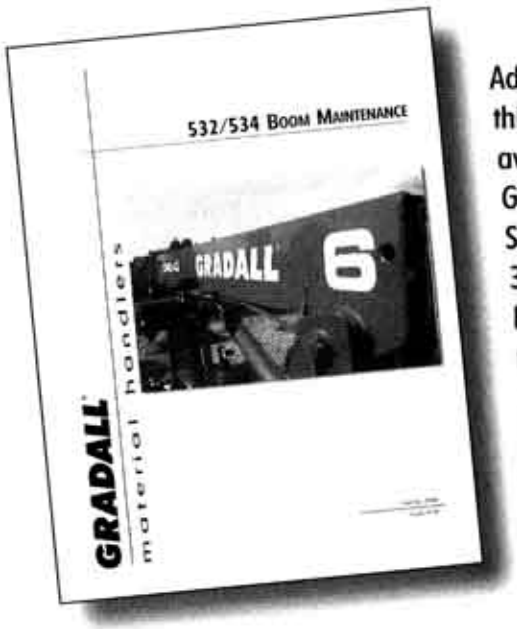
Certified ISO 9001



Additional copies of this Manual are available from Gradall Product Support. Call 330-339-2211, Ext. 385. Ask for the complete list of available Technical Manuals for Gradall Material Handlers.

GRADALL®
material handlers

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Important rim and wheel safety precautions

NOTICE!

An inflated tire and rim can be very dangerous if misused or worn-out. Many accidents, some fatal, have resulted from improper handling and operation of truck rims and wheels. It is, therefore, of the utmost importance that the precautions outlined on this page be carefully followed by all persons servicing truck rims and wheels to avoid personal injuries and costly damage.

How to prevent rim accidents during tire mounting

Always inflate tire in safety cage or use a portable lock ring guard. This is a safeguard against improper assembly, inadvertently mismatched parts, and other assembly errors. Remember, an inflated tire contains potentially explosive energy that can blow improperly assembled rings loose. In emergency situations, where a safety cage or portable safety device is not available, use a clip-on type air chuck so that the operator can stand clear during tire inflation. **Important,** when clip-on air chuck is used, line pressure must be restricted to maximum inflation capacity of tire.

Use properly matched parts only. Rim base and rings must be matched according to size and type. This information is stamped on each Firestone part.

Replace damaged parts. Abuse during road operations or in mounting the tire can cause dents, cracks, or distortions which weaken the parts. Inspect for and replace damaged parts.

Periodically inspect and remove rust and other foreign matter. Accumulation of such material in the rim gutter can prevent the proper fitting of rings. Parts that are excessively corroded are weakened and should be replaced. Use of a rust preventative compound (not containing water) during mounting will minimize rusting.

Do not use over-size or over-inflated tires. Use only recommended size rims for tires and do not exceed maximum inflation pressure for the rim.

Follow manufacturer's recommended mounting procedures.

ADDED PRECAUTION: **Re-check assemblies just prior to inflation, particularly if they have been rolled across the floor or have received rough handling between mounting and inflation.**

During tire demounting

Completely deflate tire prior to demounting. The tire should be deflated prior to removal of the tire and rim assembly from the vehicle. Remove the valve core to insure complete deflation.

DO NOT STAND IN FRONT OF RIM/TIRE DURING DEFLATION.

Follow recommended demounting procedures.

Check for damaged or worn parts. Mark defective parts for destruction to preclude their future use.

During vehicle operation

Before putting new vehicles into service, clamps and wheel nuts should be checked for proper torque.

Do not overload rims or wheels. Insure that the combination of load and vehicle weight does not exceed the rated load of the rims or wheels used. Rims and wheels are designed to sustain their rated load using the maximum tire size recommended for that rim width by the Tire & Rim Association.

Inspect rims and wheels for damage during tire checks and at periodic maintenance intervals. Remove and replace defective parts.

Do not exceed maximum inflation pressures. This is determined by the size and ply rating of the tire, but is not to exceed the maximum inflation listed for the rim or wheel. It is also important to maintain uniform inflation in both tires of a dual assembly so that weight is equally sustained.

Do not run vehicle on one tire of dual assembly. When there is loss of air in a dual tire the carrying capability is reduced and the load must be sustained by the other tire and rim. Both tires should be inflated to balanced, recommended pressures before further operation.

Never re-inflate a tire that has been run flat or seriously underinflated without first breaking rim down and reassembling rim. It is especially important to make sure the lock ring is secure in the gutter and has not been damaged prior to re-inflation.

After first 50 to 100 miles of service re-check clamp and wheel nut torque. Loose wheel nuts can cause excessive wear around bolt holes, dangerous wheel vibration, and metal fatigue failure. Excessive torque is also dangerous in that it can cause stud or wheel breakage.

THE GRADALL COMPANY
406 Mill Ave., S.W. New Philadelphia, Ohio 44663

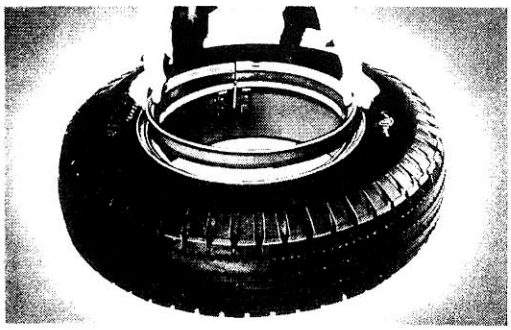
Form No. 0009

How to mount and demount ACCU-RIDE 5° Commander and 3-piece convertible rims

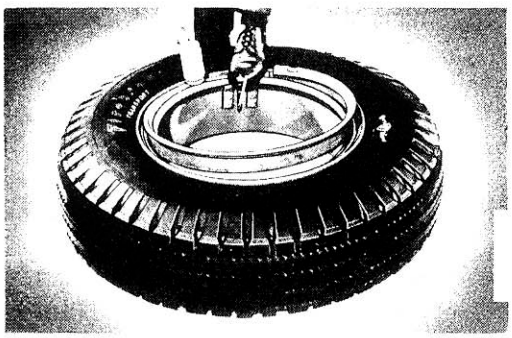
(Procedure applies to tires on both demountable rims and disc wheels)

Tools required: 1 rim mallet / 1 rim tool

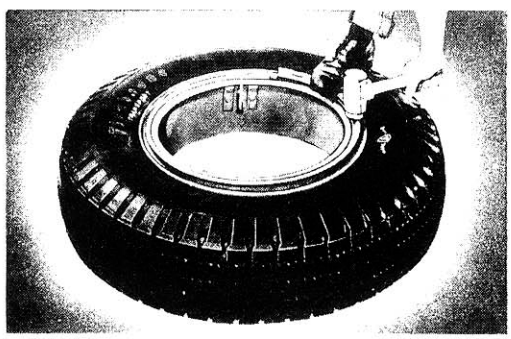
MOUNTING



After applying tire and tube in usual manner, place removable side ring (flange) on bead of tire. Then insert tapered toe of lock ring between side ring and rim base.

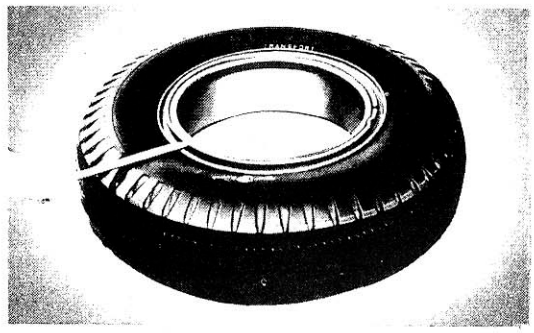


To fasten lock ring, hold with foot at one end of split and hammer end of ring into place with rim mallet.

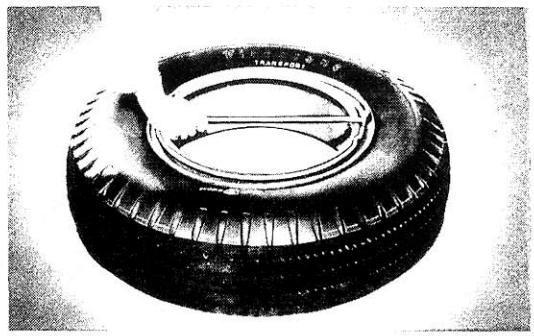


Continue progressively around the rim, holding ring with foot and hammering until entire ring is seated. Check seating of rings and inflate tire to recommended pressure.

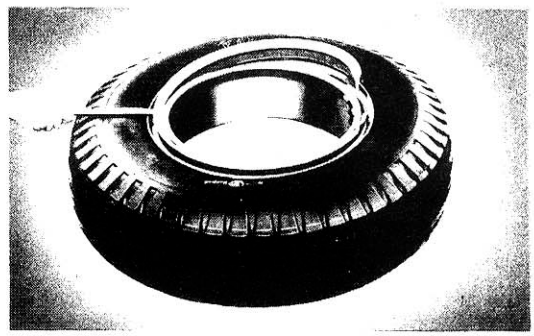
DEMOUNTING



Standing clear of rim, completely deflate tire by removing valve core or using deflator cap. Place tapered end of rim tool in depression in lock ring, or between rings, and press down on side ring to free bead. Continue downward pressure on side ring progressively around the tire until the bead is completely freed from the bead seat.



To disengage lock ring from the gutter, insert rim tool in removing notch, near split in the ring, and push downward. If desired, a second similar tool may be used to facilitate removal.



Insert the rim tool between the lock ring and side ring and press downward to pry ring up. Move progressively around the rim until lock ring is free, then lift off lock and side rings. Turn assembly over, unseat tire bead, stand tire up and remove rim base.

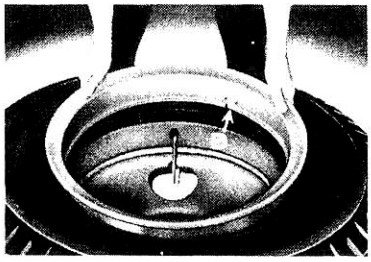
SAFETY PRECAUTIONS

1. **Use only parts free from damage or heavy rust.**
2. **Insure that lock ring is completely installed before inflating tire. Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand clear during inflation.**
3. **Insure that tire is completely deflated prior to removal of rings.**
4. **Split lock rings used with continuous side rings must not butt.**
5. **Do not inflate a flat or seriously underinflated tire while tire is on vehicle. Remove and make sure all parts are serviceable and fully reassemble before reinflating tire.**

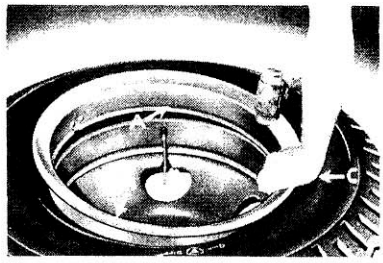
How to mount and demount ACCU-RIDE RH5° rims

Tools Required: 1 Rim Mallet
1 Rim Tool

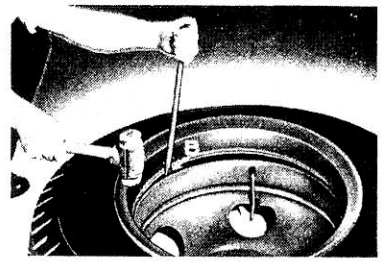
MOUNTING



Place disc portion of wheel on floor with rim gutter up. Apply tire with valve pointing in direction desired. Place side ring in position with operating notch located between two embossings (point B) approximately three inches from valve, on either side.

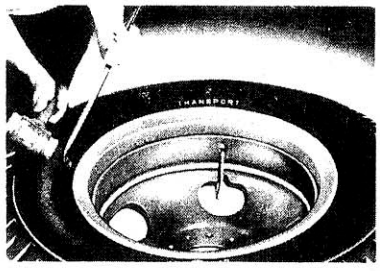


The two cutaway portions opposite each other in the inner diameter of the ring (points A) are placed so as to span the rim gutter. At point C, opposite valve, force half of ring into the gutter as far as possible using hand and rim mallet.

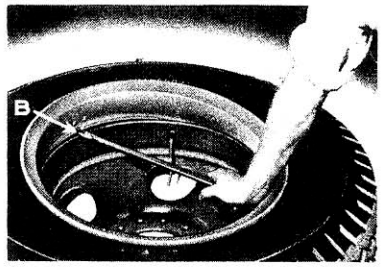


Insert straight end of rim tool in operating notch (point B), then pull in direction indicated by arrow. Retain pressure with tool and strike ring downward with mallet at point between tool slot and cutaway portion, thereby engaging ring over rim gutter at that point. Remove tool and strike additional blows progressively toward other cutaway portion until entire toe of ring has passed over the rim gutter. Check seating of ring as shown below and inflate tire to recommended pressure.

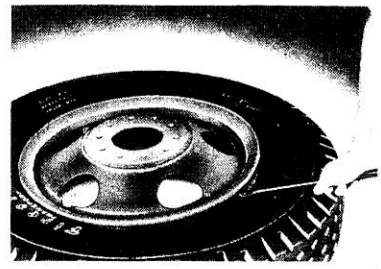
DEMOUNTING



CAUTION: Staying clear of rim, make certain tire is completely deflated. To loosen tire bead from side ring, drive curved bead-loosening end of above recommended rim tool, or a larger tire tool, between ring and bead. Pry downward on bead and repeat this operation around the ring until bead is loose.



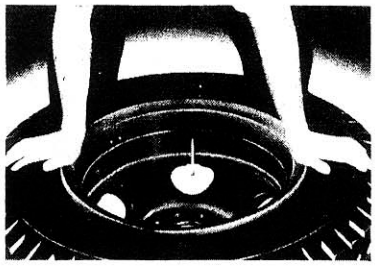
Remove ring by putting straight end of rim tool into notch in ring located between embossings (point B). Push ring downward at point opposite operating notch. Force tool handle downward as illustrated, causing ring to disengage from rim gutter. Continue operation, prying away from rim gutter with flat end of tool until free.



Turn assembly over and unseat tire bead from back flange in same manner as loosening bead from side ring in first step. Stand tire up and remove rim base.

NOTE: It is unnecessary to free the side ring from the tire bead if tire is to be removed for tube repair and immediately replaced. Simply loosen bead from back (permanent) flange as in third demounting step. Then turn the assembly over and remove ring, with tire attached, as in second demounting step.

IMPORTANT: RH-5° side rings are not interchangeable on other size RH-5° bases. Make certain side ring is right size for the rim base you are using.



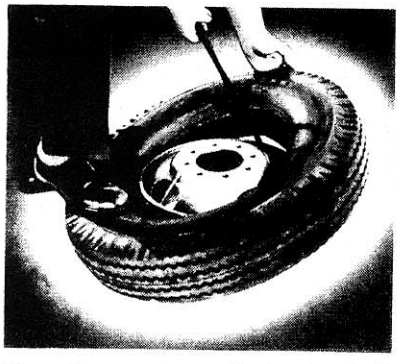
SAFETY PRECAUTIONS:

1. **Before inflating tire, be certain side ring has completely cleared the gutter of rim base. In this position, the side ring can be depressed by hand. This can be easily felt and seen. DO NOT INFLATE IF SIDE RING DOES NOT MOVE FREELY.**
2. **Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand aside during inflation.**
3. **Use only parts free from damage or heavy rust, especially at the area of contact between the rim base and side ring.**
4. **Insure that tire is completely deflated prior to removal of side ring.**
5. **Do not inflate a flat or seriously underinflated tire while tire is on vehicle. Remove and make sure all parts are serviceable and fully reassemble before reinflating tire.**

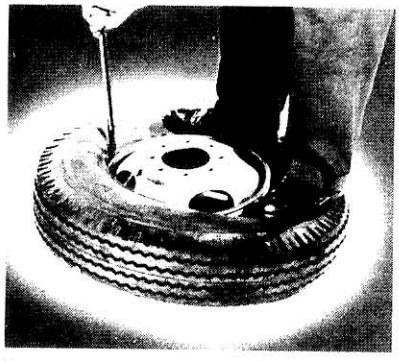
How to mount and demount ACCU-RIDE RHP rims

Tools required: 2 rim tools
1 rim mallet
1 tire tool (thin end)

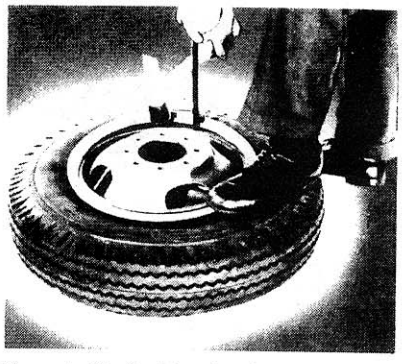
MOUNTING



Place tire on rim so that valve is in line with valve hole and insert valve through valve hole. Force first bead down into well of rim just to side of valve with foot. Mount first bead over rim gutter with rim tool progressing from each side of foot to point approximately opposite foot.

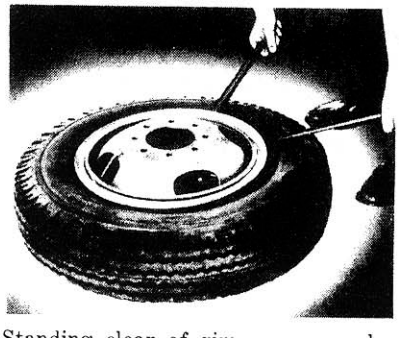


To apply second bead, start at point opposite valve and press bead toe over rim gutter and into rim well with foot pressure. Mount remainder of bead over rim gutter by means of thin tire tool, being careful not to pinch tube.

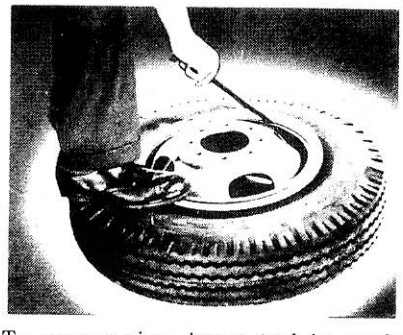


Place half of side ring in rim gutter with cutaway portions in position as shown. Insert thin end of rim tool or heavy screw driver and pull ring outward toward centered position. Strike with mallet, forcing rim into gutter.

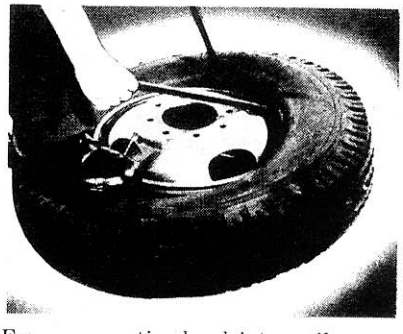
DEMOUNTING



Standing clear of rim, remove valve core to completely deflate tire. Place tire and wheel on floor with side ring up. To loosen first bead, drive hooked end of rim tool between tire and rim flange and press downward on bead. Progress around rim, using 2 tools, as shown.



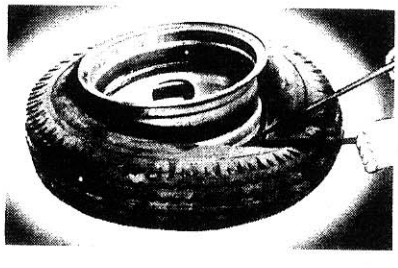
To remove ring, insert tool in notch and force ring opposite of notch into gutter, then pry off. Pry out and up on side ring, carefully but firmly. (Be careful not to bend side ring.)



Force upper tire bead into well opposite the valve slot and with tire tool pry opposite portion of bead over edge of rim.

Turn tire over and by means of rim tools, loosen bead on opposite bead seat. This can be further aided by using foot pressure.

Make sure one portion of second bead is still in the rim well, then pry opposite portion of bead over edge of rim. This will free the tire from the rim.



SAFETY PRECAUTIONS:

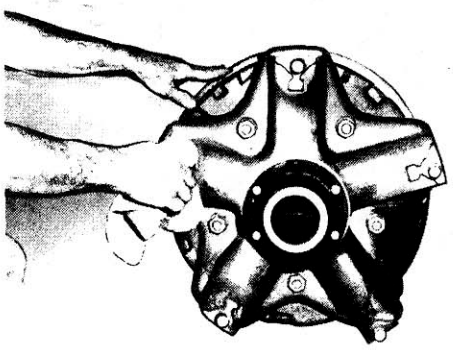
1. **Use only parts free from damage or heavy rust.**
2. **Insure that side ring is completely seated before inflating tire.**
3. **Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand aside during inflation.**
4. **Insure that tire is completely deflated prior to removal of rings.**
5. **Do not mount 16.5 diameter tubeless tires on 16" diameter rims.**

How to properly install ACCU-RIDE rims and wheels

Proper installation of rims and wheels on a vehicle is essential to safe, economical, trouble-free service. Use only the specified sizes of studs, nuts and clamps.

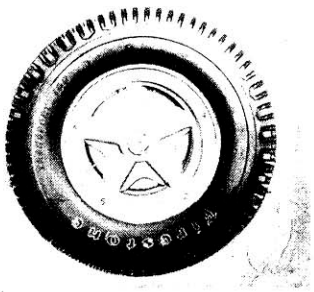
RECOMMENDED INSTALLATION PROCEDURE

DEMOUNTABLE RIMS



Make sure that all parts, including rims, rings, spacer bands and cast wheel studs are free from damage, dirt or rust. Replace any defective parts.

Place rims and spacer band on wheel. Secure clamps evenly in position and draw up nuts alternately in the sequence shown at right. Do **not** tighten them fully, however. This procedure will permit the inside rim to properly align itself on the 28° mounting bevel on the back of the cast wheel, thus avoiding damaging wheel wobble.



Then, tighten nuts fully, using same alternate sequence. Be sure to tighten these nuts **only** to the torque level recommended in the table below and to maintain them at that level through planned, periodic checks.

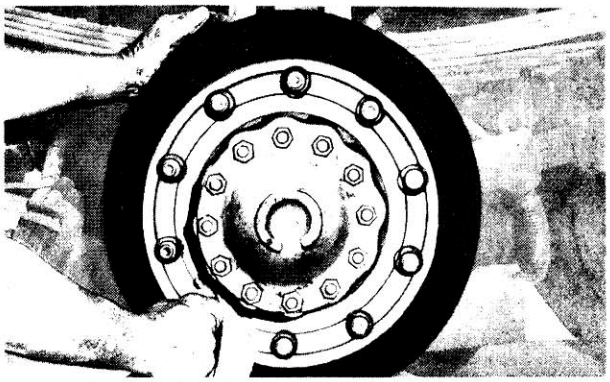
SPOKE WHEELS*	
Thread Size	Torque Ft.-Lbs. (Dry)
5/8 - 11	150 - 175
3/4 - 10	200 - 250
1 - 8	400 - 450
1 - 14	400 - 450

CAUTION: *Insufficient* mounting torque can cause rim slippage, resulting in broken valves, worn parts and damaged tires. *Excessive* mounting torque can cause damage by stripping studs, collapsing spacer bands or forcing rims into an out-of-round condition.

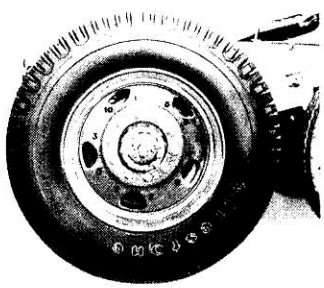
Wrenches for Demountable Rims and Disc Wheels: Double-end socket wrenches for rims and disc wheels normally are adequate to install and remove Accu-Ride rims and wheels, when used with a 3-foot bar. A 150-pound man, exerting his entire weight, 2.5 feet out on a bar, can apply 375 foot-pounds of torque to a wrench (150 x 2.5). Air wrenches, however, sometimes are used to save time and labor. The torque they deliver depends on the air line pressure from which they operate. Periodic checks by torque wrench, or other means, should be made to insure accuracy of these air wrenches.

***NOTE: After first 50 to 100 miles of service re-check clamp & wheel nut torque.**

DISC WHEELS



Check all parts for damage, including wheels and rings. Insure that studs, nuts and mounting faces of hub and wheels are clean and free from grease. Replace any defective parts.



Mount single wheel or inner dual wheel (also, outer dual wheel for hub - type mounting) over studs, being careful not to damage stud threads. Draw up nuts alternately in the sequence shown at left. Do **not** tighten them fully, however. This procedure will permit the uniform seating of nuts and insure the even, face-to-face contact of wheels and hub.

Tighten nuts fully, using the same alternate sequence. Mount the outer wheel (for double cap mounting) and repeat the entire procedure. In each case, be sure to tighten wheel nuts only to the torque level recommended in the table below and to maintain them at that level through planned, periodic checks.

Note: When inner cap nuts are re-tightened, be sure first to loosen outer cap nuts several turns; then, re-tighten them.

DISC WHEELS*		
Application	Thread Size	Torque Ft.-Lbs. (Dry)
Passenger Type Mtg.	7/16-20	80-90
	1/2-20	80-90
	9/16-18	110-120
	5/8-18	125-140
In-Out Coined Mtg.	9/16-18	175-200
	5/8-18	175-200
		1-pc. nut / 2-pc. nut
Piloted Mtg.	11/16-16	300-350 / 200-250
	3/4-16	450-500 / 300-350
	7/8-14	..... / 350-400
Ball Seat Mtg.	3/4-16	450-500
	1-1/8-16	450-500
Heavy Duty Ball Seat Mtg.	15/16-12	750-800
	1-5/16-12	750-800

CAUTION: *Insufficient* mounting torque can cause wheel shimmy, resulting in damage to parts and extreme tire tread wear. *Excessive* mounting torque can cause studs to break and discs to crack in the stud hole area.

Proper maintenance of ACCU-RIDE rims and wheels

Accu-Ride rims and wheels are thoroughly tested in Firestone laboratories, on Firestone test tracks and by both small and large fleets on the highways of America. All these tests, plus a rigid quality-control program, insure maximum performance of all Accu-Ride rims and wheels. In order, however, to maintain their built-in quality and to insure maximum service and safety a continuous maintenance program is advisable. Maintenance procedures should be carried out during all tire inspections and changes and at periodic maintenance intervals depending upon road and environmental conditions of operation.

RIM AND WHEEL MAINTENANCE DURING TIRE INSPECTIONS

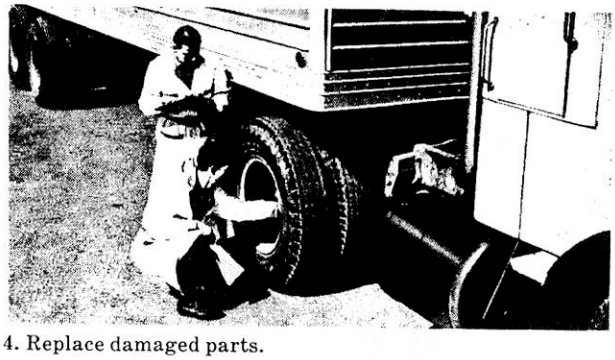
1. Check all metal surfaces thoroughly while making tire inspections, including areas between duals and on inboard side of wheel. Watch for:

excessive rust or corrosion build-up
cracks in metal
bent flanges, resulting from road obstructions
deep rim tool marks on rings or in gutter areas
loose, missing or damaged nuts or clamps
bent or stripped studs
damaged or missing rim drive plates
matched rim parts

2. Pull damaged rims or wheels.

CAUTION: Excessively corroded or cracked rims or rings can be dangerous. Deflate tires prior to the removal of rims or wheels from the vehicle.

3. Mark damaged or hazardous areas with chalk so that part will be removed from service.



4. Replace damaged parts.

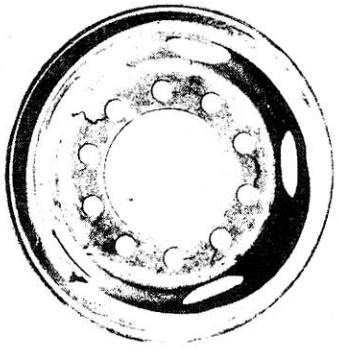
CAUTION: Insure that replacements are made with the proper sizes and types of rims and rings.

5. Inflate tires only to recommended air pressures.

RIM AND WHEEL MAINTENANCE DURING TIRE CHANGES

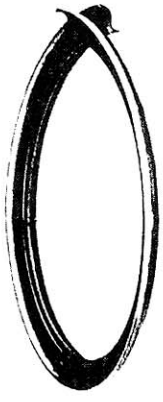
1. Check all metal surfaces as in No. 1, above. A more thorough check may be made, however, after the tire has been demounted. Watch particularly for the damages illustrated below and refer to recommendations in this section of the catalog if corrective measures are required.

Cracks in the rim base, in the back flange and gutter areas. These are caused by deep rim tool marks, overloading and overinflating tires and using larger than recommended tire sizes.



Cracks in the wheel disc, between stud holes or hand holes. These are caused by loose wheel nuts, improper installation procedures and use of incorrect sizes or types of attaching parts.

Cracks through side ring, spreading laterally through the entire section. These are caused by improper mounting and demounting techniques, impact with road obstructions, and excessive clamping torques.



Sprung side ring, resulting from improper mounting procedures.

Erosion and chipping of bead seat of lock ring, resulting from excessive corrosion. This may occur with this part as well as others if protective measures described on following page are not taken.

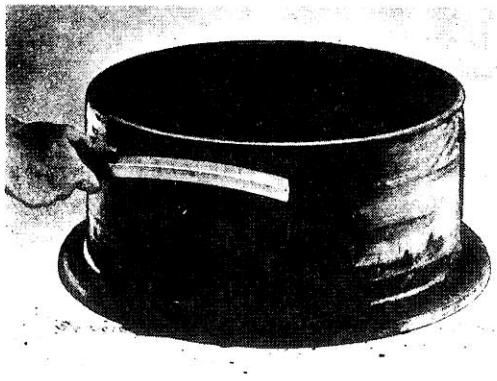
2. Replace damaged parts.

CAUTION: Insure that replacements are made with the proper sizes and types of rims and rings.

NOTE: Openings between ends of split side rings must not be less than 3/32" except where the ring design calls for an abutting condition, or more than 5/16" after ring is seated-in during operation. Split lock rings used with endless side rings must not butt.

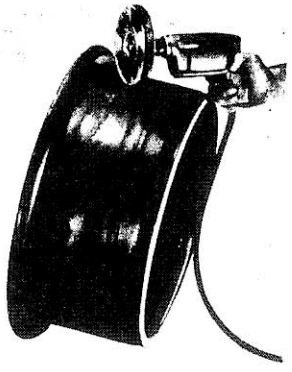
(Continued)

Proper maintenance of ACCU-RIDE rims and wheels
(continued)

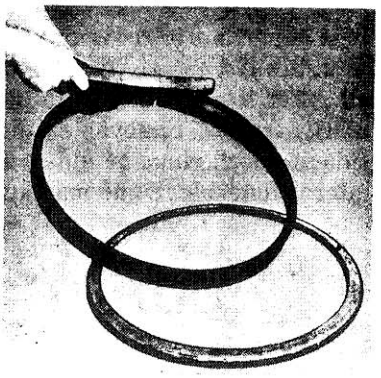


3. Thoroughly remove rust, dirt and other foreign materials from all surfaces. Hand or electric wire brushes, sand blasting or chemical baths may be used.

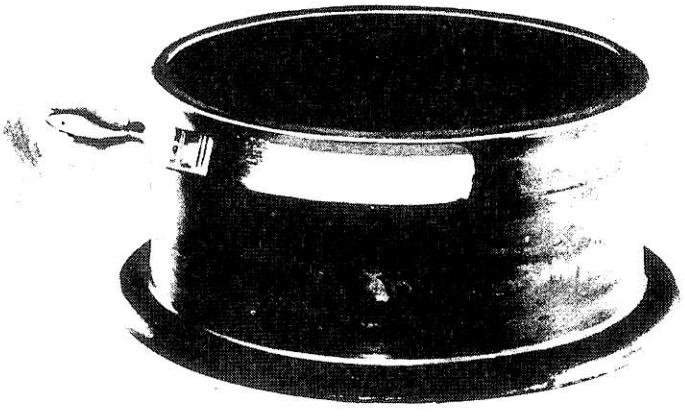
Gutter of rim base should be cleared of rust and other materials obstructing safe, positive seating of rings.



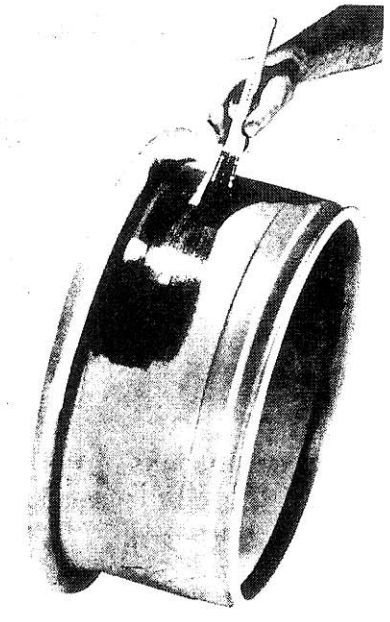
Bead seat areas of rim should be free of rust and rubber deposits. This is especially important for drop-center tubeless rims, because the 15° bead seat is the air-sealing element.



Rings should be cleaned with wire brush. Pay particular attention to seating surfaces and bead seat areas.



4. Paint rim by brush or spray with a fast-drying metal primer. Surfaces should be clean and dry prior to painting. Insure that bare metal areas on outside or tire side of rim are covered. This is especially important on drop-center tubeless rims, because warm and sometimes moist air is in constant contact with the metal surface on the tire side of the rim.

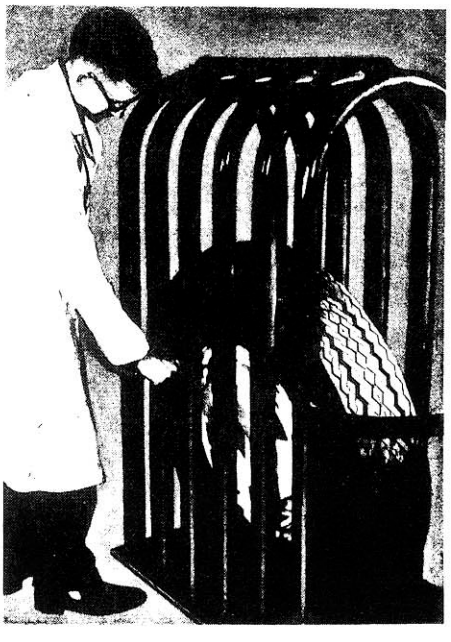


5. Lubricate tire side of rim base just prior to mounting tire. Avoid the use of any lubricant which contains water or solvent that is injurious to rubber. A combination lubricant and rust-preventive compound is preferable. This protective measure is of particular importance with drop-center tubeless rims as the air in the tire is contained by the tire-side rim surface.

6. Inflate tire only to recommended air pressure.

SAFETY PRECAUTIONS

1. **Insure that rings are properly seated, prior to inflation.**
2. **Use safety cage or lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck, so that operator may stand aside during inflation. When clip-on air chuck is used, pressure must be restricted to max. inflation capacity of tire or rim, whichever is lower.**
3. **Air tank should incorporate moisture trap when used with drop-center tubeless rims in order to reduce the moisture in contact with the metal rim surfaces.**



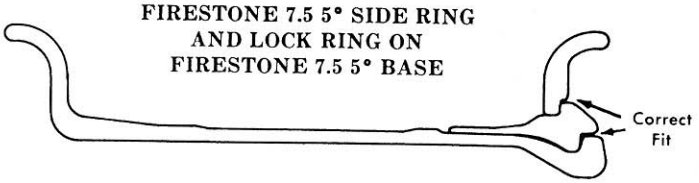
How to Insure Greater Safety and Service by Properly Matching Side and Lock Rings

It is important to recognize that the various types of highway rims produced by their manufacturers all differ to some degree in design. This is particularly true of removable rings and, as a result, side and lock rings of different rim types are not interchangeable. Some may appear to be, but they actually do not fit properly on the rim base. Serious accidents to personnel have resulted from the use of mismatched rings.

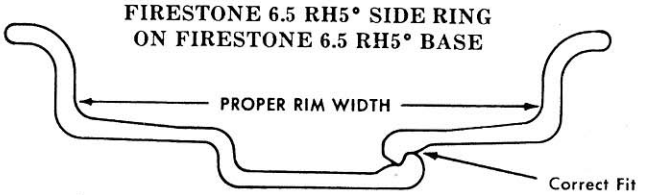
The drawings below illustrate a few of the potentially dangerous conditions which can result from the mismatching of rings and bases.

CORRECT

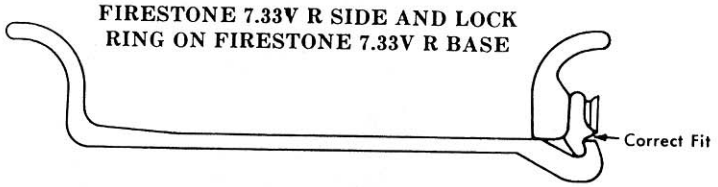
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON FIRESTONE 7.5 5° BASE



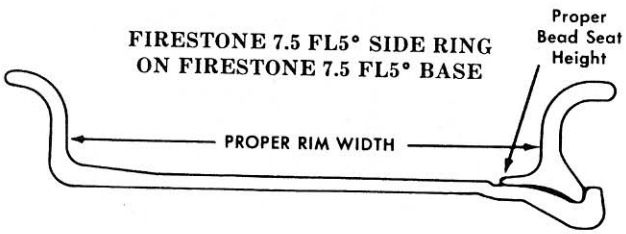
FIRESTONE 6.5 RH5° SIDE RING ON FIRESTONE 6.5 RH5° BASE



FIRESTONE 7.33V R SIDE AND LOCK RING ON FIRESTONE 7.33V R BASE

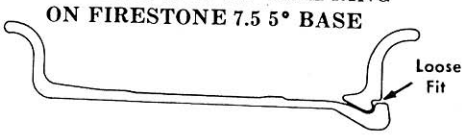


FIRESTONE 7.5 FL5° SIDE RING ON FIRESTONE 7.5 FL5° BASE

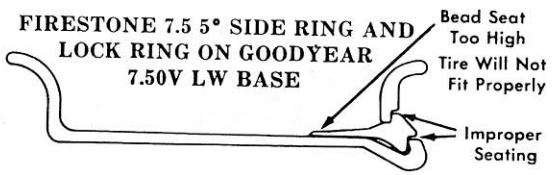


INCORRECT

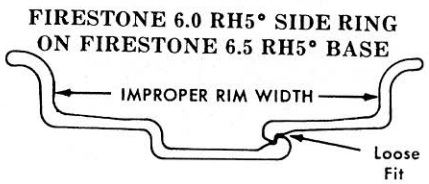
GOODYEAR 7.50V LW SIDE RING ON FIRESTONE 7.5 5° BASE



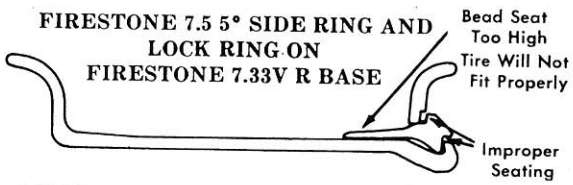
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON GOODYEAR 7.50V LW BASE



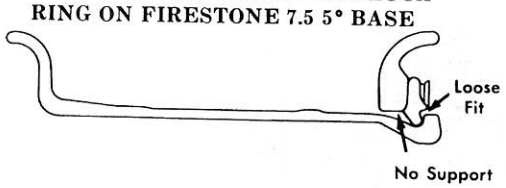
FIRESTONE 6.0 RH5° SIDE RING ON FIRESTONE 6.5 RH5° BASE



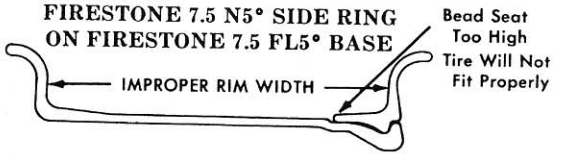
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON FIRESTONE 7.33V R BASE



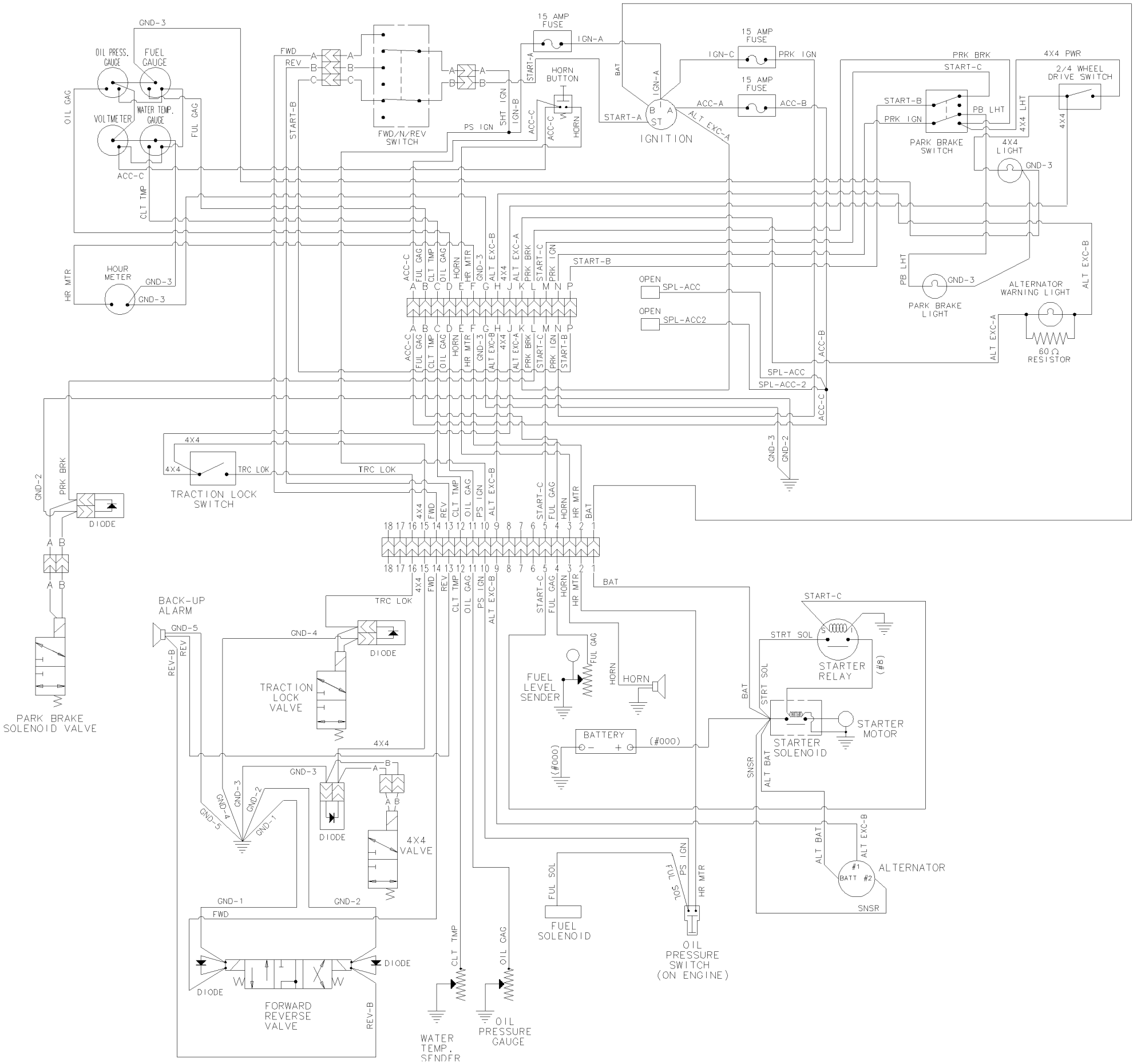
FIRESTONE 7.33V R SIDE AND LOCK RING ON FIRESTONE 7.5 5° BASE



FIRESTONE 7.5 N5° SIDE RING ON FIRESTONE 7.5 FL5° BASE



NOTE: When in doubt of component compatibility, refer to the U.S. Department of Transportation, National Highway Traffic Safety Administration's Multipiece Rim / Wheel Matching Chart. Chart is available from D.O.T. NHTSA Office of Defect Investigation, all rim and wheel distributors and all Firestone Sales Offices.



KEY		
WIRE DESIGNATION	WIRE COLOR/STRIPE	WIRE GAGE
ACC-A	ORANGE/TAN	16
ACC-B	ORANGE/BLUE	16
ACC-C	ORANGE/RED	16
ALT BAT	RED/WHITE	6
ALT EXC-A	VIOLET/RED	16
ALT EXC-B	VIOLET/RED	16
BAT	RED	8
CLT TMP	BLUE/VIOLET	16
FUL GAG	BLUE/BLACK	16
FUL SOL	VIOLET	16
FWD	BROWN/WHITE	16
GND-1	BLACK	16
GND-2	BLACK	16
GND-3	BLACK	16
GND-4	BLACK	16
GND-5	BLACK	16
HORN	VIOLET/YELLOW	16
HR MTR	BLUE/RED	16
IGN-A	ORANGE/GRAY	16
IGN-B	ORANGE/LT GREEN	16
IGN-C	ORANGE/DK GREEN	16
OIL GAG	BLUE/BROWN	16
PB LHT	BLUE/YELLOW	16
PRK BRK	VIOLET	16
PRK IGN	ORANGE/BLACK	16
PS IGN	ORANGE/YELLOW	16
REV	BROWN/YELLOW	16
REV-B	BLUE	16
SHT IGN	ORANGE/BROWN	16
SNSR	RED/BLACK	16
SPL ACC	ORANGE	16
SPL ACC2	ORANGE/VIOLET	16
START-A	VIOLET/BROWN	16
START-B	VIOLET/BROWN	16
START-C	VIOLET/BROWN	16
STRT SOL	RED/VIOLET	10
TRC LOK	BROWN/GRAY	16
4X4	BROWN	16
4X4 LHT	BLUE/VIOLET	16
4X4 PWR	VIOLET	16

ELECTRICAL SCHEMATIC

524 534C-6 534C-9 534C-10 LPR-60

9114-9012

Cyclopac® Service Procedures

Proper air cleaner servicing results in maximum engine protection against the ravages of dust. Proper servicing can also save time and money by maximizing filter life and dust cleaning efficiency.

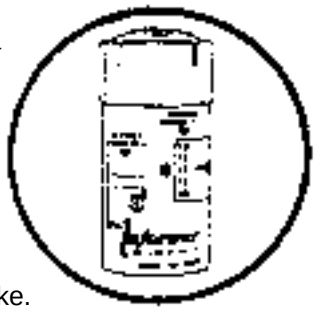
Two of the most common problems:

A) Over Servicing. New filter elements increase in dust cleaning efficiency as dust builds up on the media. Don't be fooled by filter appearance.... the filter should look dirty. By using proper filter measurement tools you will use the full life of the filter at maximum efficiency.

B) Improper Servicing. Your engine is vulnerable to abrasive dust contaminants during servicing. The most common cause of engine damage is careless servicing procedures. By following the steps shown, you can avoid unnecessary risk to the engine.

Measure Restriction

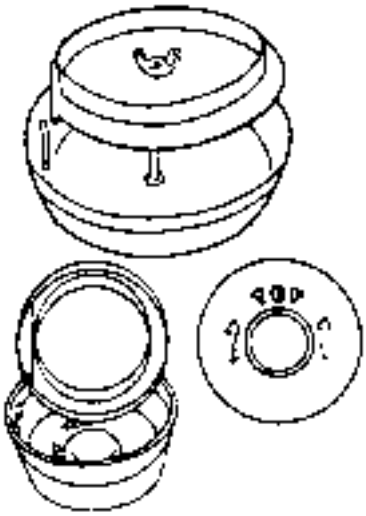
Measure the restriction of the air cleaner with a Donaldson restriction indicator, such as The Informer, a service gauge, or water manometer at the restriction tap provided in the air cleaner, the transfer pipe, or the blower intake.



One of two conditions will exist
(1) If the reading indicates the maximum restriction (per engine manufacturer's recommendations), change out the filter.
(2) If the reading shows below the maximum, the filter still has life left and should not be touched.

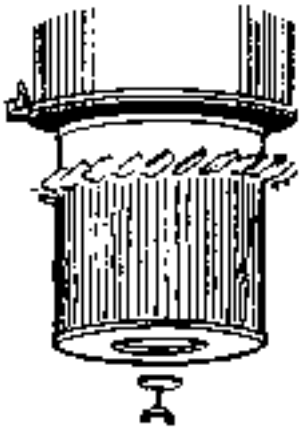
Empty the Dust Cup

Dust should not be allowed to build up closer than one inch from the baffle. On models equipped with a Donaldson Vacuator valve, dust cup service is cut to a minimum; all that is necessary is a quick check to see that the Vacuator valve is not inverted, damaged, or plugged.



Filter Servicing

When restriction indicates that filter servicing is required, loosen the wingnut and remove the primary filter. Before installing new filter, inspect the filter and gasket for shipping or storage damage. (See service tips on reverse side of this document.) Carefully install new element and wingnut.



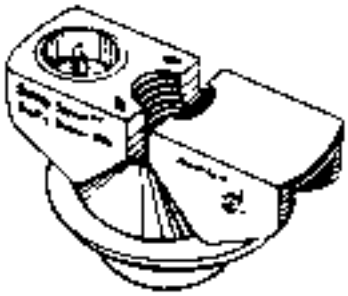
Always use authentic replacement Donaldson filters, which have been engineered to fit the air cleaner and engine intake system exactly.

Cover the Inlet

Don't leave the air inlet exposed! If the new filter won't be installed immediately, cover the opening to prevent stray contaminant from entering the induction system.

Safety Element Service

For Maximum engine protection and air cleaner service life, replace the safety filter **every third** primary filter change or cleaning, or as indicated by the Donaldson Safety Signal service indicator. Note that the safety element is not intended to be cleaned.



Reinstall the Dust Cup

Be sure the dust cup is sealed 360° around the air cleaner body. Reset the restriction indicator to green.

Check Connections

Ensure that all connections between the air cleaner and the engine are tight and leak-free.

Donaldson®

Air Filter Service Tips

7 Important Steps to Follow

(1) Remove the old element gently to prevent knocking dust off of it.

2) Always clean the inside of the housing carefully

3) Always clean the gasket sealing surfaces of the housing

4) Check for uneven dirt patterns in your old filter that indicate gasket leakage

5) Press your fresh gasket to see that it springs back

6) Make sure the gasket seats evenly

7) Ensure an airtight fit on all connections and ducts

T

The Important "Don't"

<u>Don't</u> remove filter for inspection.

Never rap a filter to clean it. Rapping only damages the filter.

<u>Never</u> judge the filter's life by looking at it. Measure how restricted its airflow is.

<u>Never</u> leave an air cleaner open longer than necessary.

<u>Don't</u> ignore a worn or damaged gasket in the housing....replace it!

Don't use a damaged or bunched filter.

Never use a warped cover on a housing.

Never substitute an incorrect filter model number.

Brochure No. F114004 (4/96) Replaces 1400-23

For more Information, Contact:

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Open Center HYDRAULIC POWER BRAKE VALVE

SERVICE MANUAL

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SYSTEM SCHEMATIC (TYPICAL)

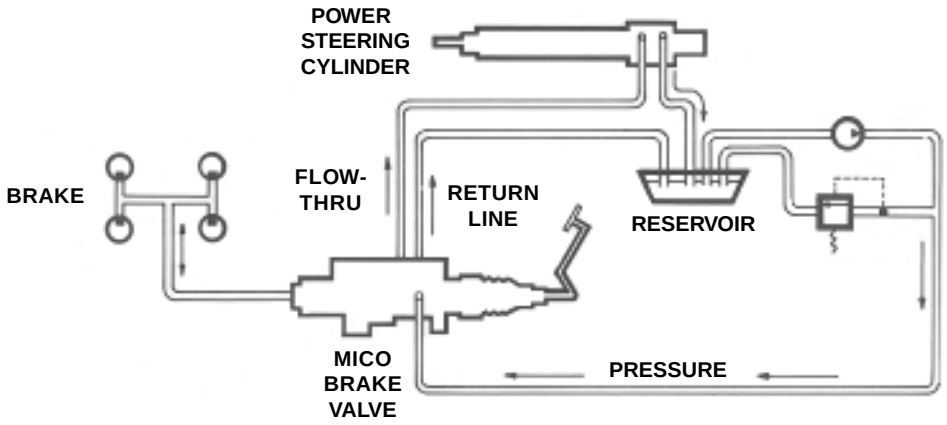


FIGURE 1

PERFORMANCE DATA (Typical)

Flow capacity.....See Specification Chart (page 7)
System pressure.....0 - 2000 psi
Brake line pressure.....See Specification Chart (page 7)
Master cylinder, capacity.....3.1 $in.^3$
Push rod travel with power.....0.2" (approx.)
Push rod force with power..... .340 lbs. at 1500 psi brake line pressure
225 lbs. at 250 psi brake line pressure (Model 06-460-652 only)
Push rod travel without power.....1.844" (approx.)
Push rod force without power.....1500 lbs. at 725 psi
518 lbs. at 250 psi (Model 06-460-652 only)

NOTE: Brake system rubber parts (Buna-N) must be compatible with mineral based hydraulic oil.

DESCRIPTION AND OPERATION OF THE MICO OPEN CENTER HYDRAULIC POWER BRAKE VALVE

The MICO Open Center Brake Valve will provide hydraulic power braking when installed in an open center hydraulic circuit. It can be used in conjunction with other hydraulic devices such as power steering, also installed in the same circuit. Using a single pump to provide flow and pressure, the brake valve should be installed in the system circuitry, in series, between the pump relief valve and the other hydraulic devices. The entire pump flow is directed thru the brake valve and is available to actuate the downstream devices. The brake valve requires a very small volume of oil for its operation; therefore, it does not interfere with the rest of the circuit, nor does usual actuation of the downstream hydraulic devices affect operation of the brake valve . Full system pressure is always available for operating the rest of the system.

The MICO Brake Valve provides a single-fluid system using the systems hydraulic oil to operate the brakes. Synthetic rubber wheel-cylinder cups must be used to prevent swelling.

This valve reduces the braking effort to any required degree depending on pedal ratio. Brake pedal force is directly proportional to brake line pressure, thus giving a sense of feel in the operation of the brakes. Manual braking is always available whenever the hydraulic power system is not functioning. This is accomplished by a mechanical follow through within the brake valve. A longer pedal stroke, usually with increased pedal effort, will be expected when braking in this condition.

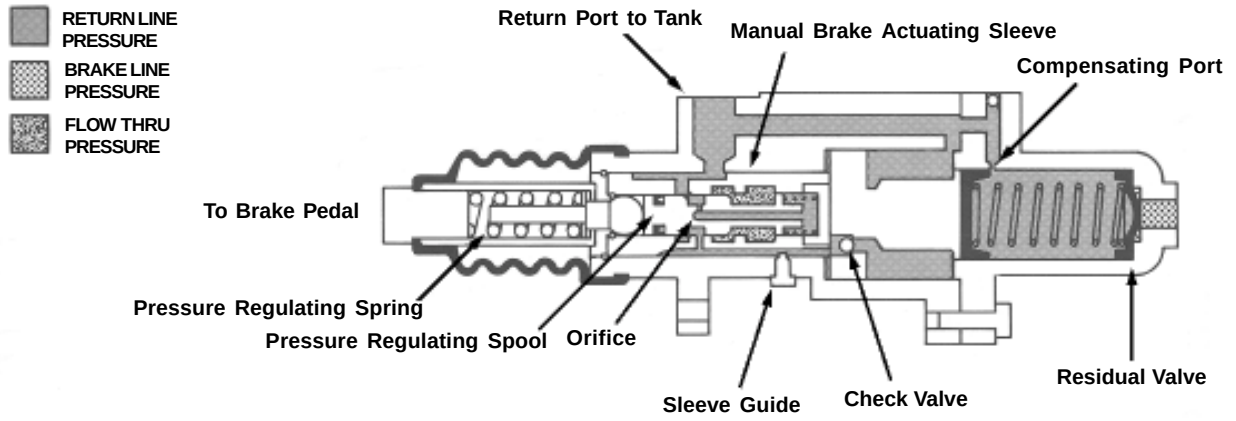
The manner in which the hydraulic power brake valve funtions will be discussed in the following paragraphs.

Oil from the pump flows through the brake valve and on to the downstream hydraulic unit as indicated (Figure 3). Sections of the valve which are communicated to the return port and the tank when the valve is not operating are shown (Figure 2). The compensating port (Figure 2) provides for thermal expansion of the oil in the brake lines and the master cylinder.

The residual valve (Fig. 2), if used, maintains pressure of 12-20 PSI in the brake lines when the pedal

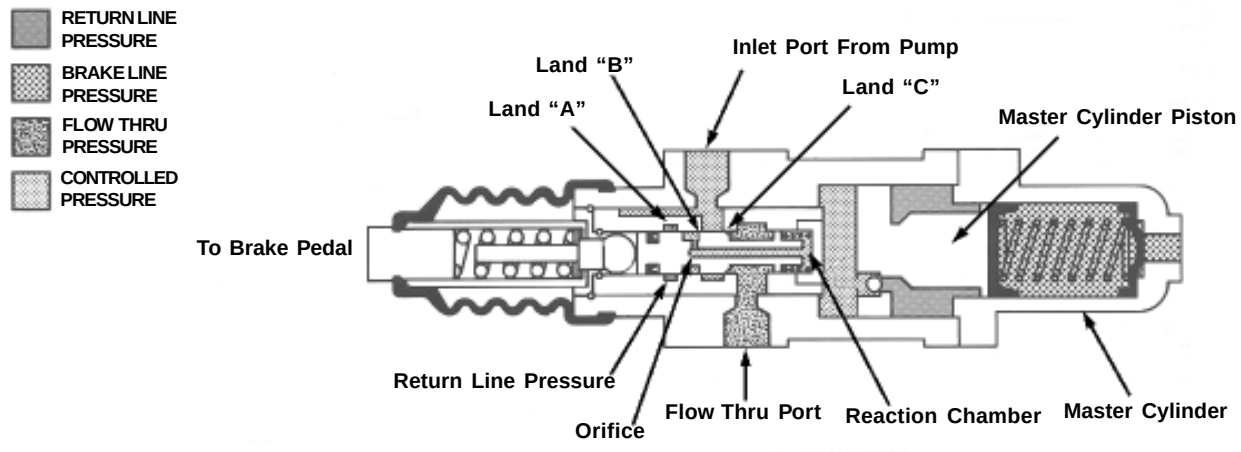
Schematic of Brake Valve in Neutral

FIGURE 2

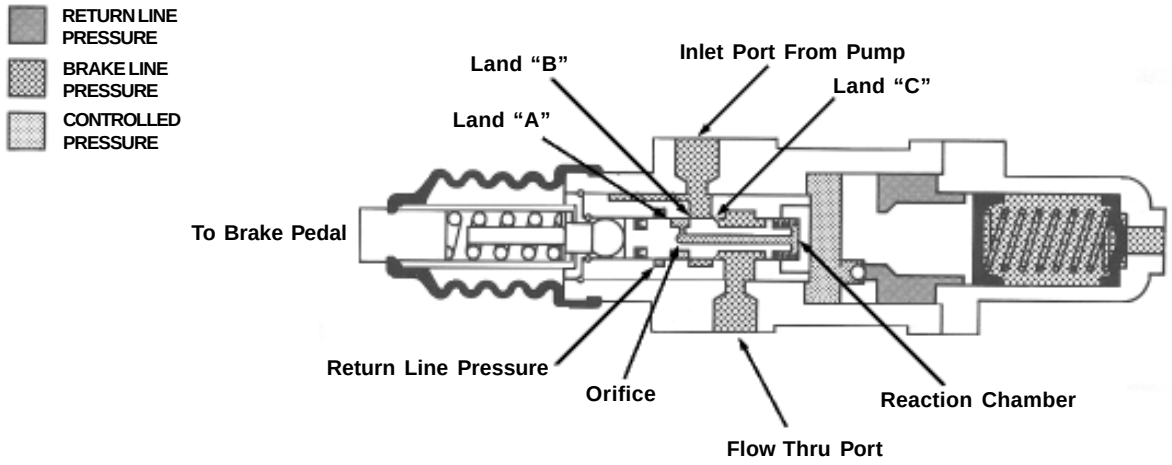


Brake Valve Actuated -- Power Steering in Neutral

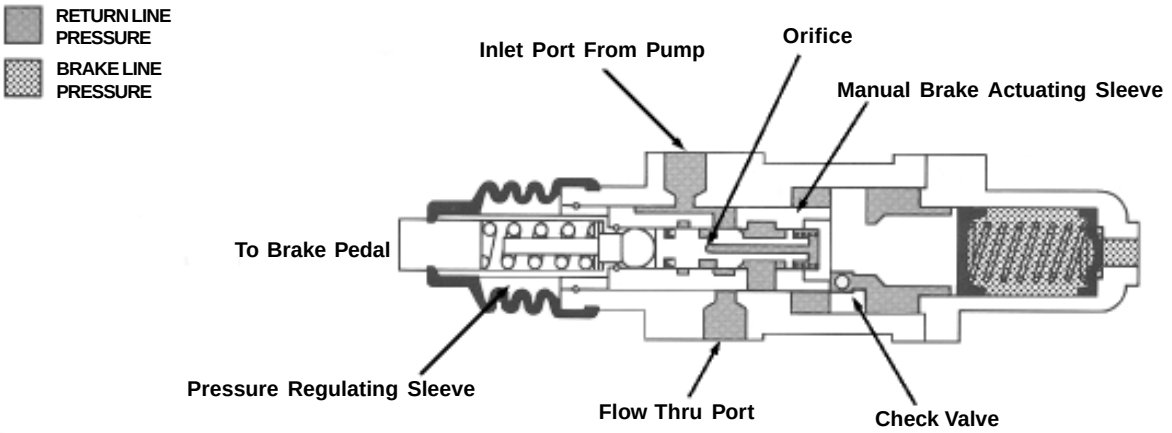
FIGURE 3



Hydraulic System Pressure Equal to Brake Line Pressure **FIGURE 4**



Schematic of Brake Valve in Manual Operation **FIGURE 5**



is released. In drum brake systems, this low pressure aids in preventing air from entering the brakes when the vehicle is at rest. The residual valve is removed from models designed for disc brake systems because of the drag which would develop in this type of brake, even at these relatively low pressures.

When force is applied to the brake pedal, this force acts through the PRESSURE REGULATING SPRING to shift the PRESSURE REGULATING SPOOL restricting the flow of oil at LAND "C" to build up pressure when there is no requirement for pressure to the power steering or other hydraulic device (Figure 3). As the pressure builds up, a small amount of oil flows through the ORIFICE and down through the passage inside the spool to the REACTION CHAMBER (Figure 3). At the same time, oil flows along a groove in the outside diameter of the MANUAL BRAKE ACTUATING SLEEVE into the chamber ahead of the MANUAL BRAKE ACTUATING SLEEVE (Figure 2). Flow to the area ahead of the MANUAL BRAKE ACTUATING SLEEVE moves the MASTER CYLINDER PISTON, building up pressure in the MASTER CYLINDER which, in turn, builds pressure in the brake lines. Pressure in the REACTION CHAMBER moves the SPOOL back a small amount against the PRESSURE REGULATING SPRING, and when the hydraulic pressure balances against the PRESSURE REGULATING SPRING the pressure is controlled to the MASTER CYLINDER. The ORIFICE controls the rate of flow to the REACTION CHAMBER; hence, the rate of pressure increases and stability of the pressure regulating spool is controlled. Therefore, system efficiency is maintained since the power brake valve does not momentarily take all of the fluid from the pump. When the pedal effort is released, the spring in the REACTION CHAMBER returns the pressure regulating spool to neutral. This closes LAND "B" to pressure and opens LAND "A" which allows the oil ahead of the spool in the REACTION CHAMBER to flow to the return port as well as the oil ahead of the MANUAL BRAKE ACTUATING SLEEVE. The spring in the MASTER CYLINDER returns the MASTER CYLINDER PISTON.

In case the downstream power hydraulic system requires a pressure that is equal to or greater than

one-half the brake line pressure, the PRESSURE REGULATING SPOOL shifts a minute amount and the pressure is regulated across LAND "A" and LAND "B" (Figure 4).

If the pressure required by the brake valve is lower than that required by the power steering, the power steering will not normally interfere with the operation of the brake (Figure 4).

NOTE: Brake line pressure can exceed preset specifications in the unusual condition of a simultaneous brake application and sudden elevation of the steering pressure above the value.

In the standard MICO Open Center Valve, the pressure in the REACTION CHAMBER and ahead of the MASTER CYLINDER PISTON is equal to one-half of the brake line pressure. To accomplish this, the area of the MASTER CYLINDER PISTON is twice the area of the MASTER CYLINDER. Therefore, any pressure that is applied to the MASTER CYLINDER PISTON will be multiplied by two to determine the master cylinder pressure. The pressure regulating spring can be factory set to normally limit brake line pressure regardless of system pressure.

This valve will act as a manual brake master cylinder, in the event of failure in the hydraulic circuit supplying power to it. The PRESSURE REGULATING SLEEVE contacts the MANUAL BRAKE ACTUATING SLEEVE which, in turn, pushes directly on the master cylinder piston, thereby building pressure in the MASTER CYLINDER (Figure 5). This requires a longer stroke in the pedal. This amount of pressure that can be generated in the brake lines in manual operation is proportional to the pedal ratio and the effort which the operator is able to exert on the pedal. In most cases, the operator is not able to build as much pressure in the brake line as can be done in power operations. The ports from the pump are restricted when the valve is actuated manually; however, as soon as the engine is started, hydraulic pressure will push the MANUAL BRAKE ACTUATING SLEEVE back against the retaining ring which contains it and the valve again functions with power. This is rather an abrupt action when the engine is started, causing the brake pedal to return to its power mode position, and it is suggested that the brakes not be applied manually when starting the engine.

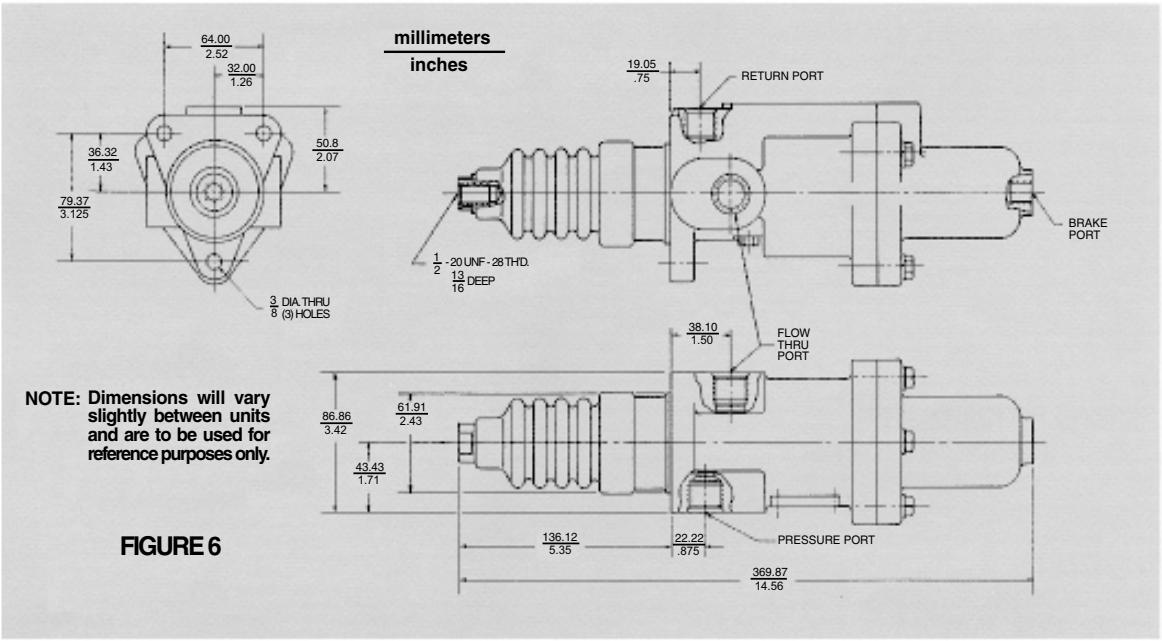


FIGURE 6

INSTALLATION INSTRUCTIONS

1. Mount MICO Open Center Power Brake Valve on vehicle and complete push rod and pedal hook-up. NOTE: It is important that the system reservoir be mounted above the brake valve, or that the return line have a vertical section of one foot directly above the valve.
2. The pedal assembly must have its own return spring. DO NOT rely on the internal spring in the valve for this function.
3. Pedal should be adjusted to allow 1/32" clearance between pressure regulating rod and actuator.
4. Bleed system (see bleeding instruction on page 14).
5. Be sure all hydraulic fittings are tight and visually check system for leaks with power applied.

THREE OPEN CENTER HYDRAULIC POWER BRAKE VALVE DESIGNS

PRIMARY CUP DESIGN

The Primary Cup Design uses a residual valve. This valve will maintain a pressure of 12 - 20 PSI in the brake lines when the pedal is released. When used in drum brake systems this low pressure aids in preventing air from entering the brakes when the vehicle is at rest.

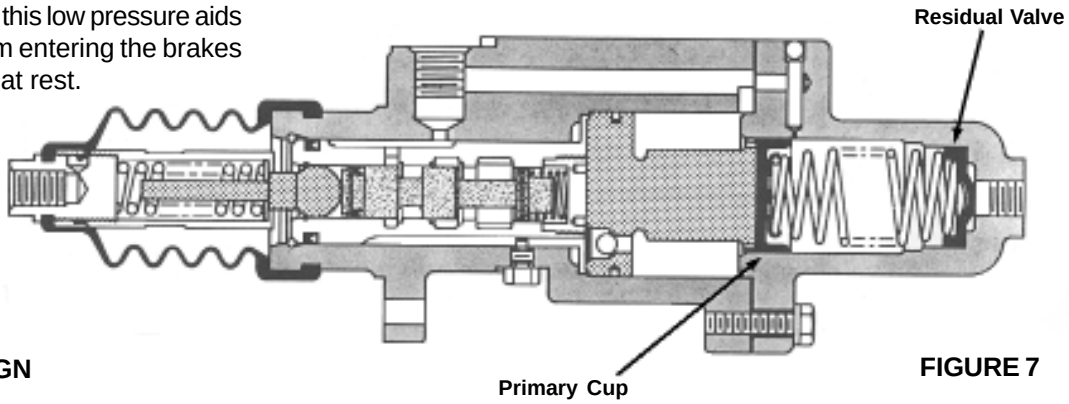


FIGURE 7

RING SEAL DESIGN

The Ring Seal Design is used mainly in disc brake systems. The residual valve is removed from models designed for disc brake systems because of the pressure they maintain in the brake lines when the pedal is released. Even these relatively low pressures (12 - 20 PSI) would develop drag in this type of brake.

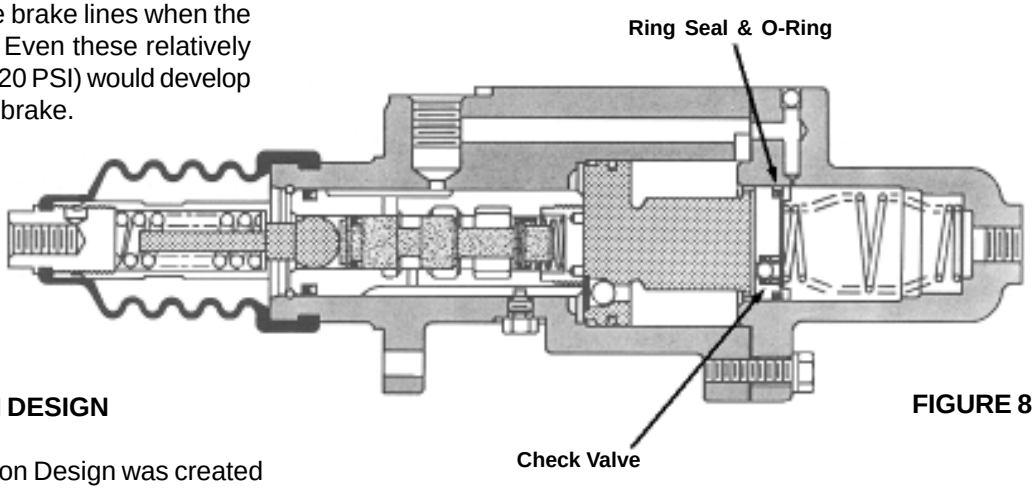


FIGURE 8

SLIDING PISTON DESIGN

The Sliding Piston Design was created with a specific function in mind. A specially designed piston slides inside the primary piston when the brake pedal is actuated. If primary piston strokes too far, the brake pedal will be pulled down with a short abrupt stroke. This indicates to the operator that maintenance is required.

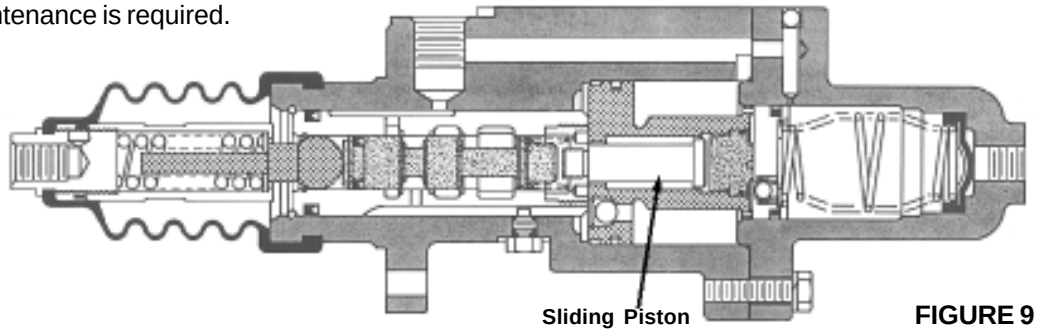


FIGURE 9

SPECIFICATIONS CHART

Part Number	Brake Port	Pressure Port	Flow Thru Port	Return Port	Brake Line Pressure (with power)	Flow Capacity
* 06-460-520	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1850 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-658						
06-460-522	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1850 psi ± 50 psi	3-24 gpm
* 06-460-550	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
* 06-460-560	1/2-20 UNF	SAE No. 8	SAE No. 8	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
* 06-460-570	9/16-18 UNF	SAE No. 8	SAE No. 8	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-662						
* 06-460-580	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
* 06-460-588	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-664						
* 06-460-610	9/16-18 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	950 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-666						
* 06-460-620	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
06-460-642	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
* 06-460-650	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
* 06-460-654	9/16-18 UNF	SAE No. 8	SAE No. 8	SAE No. 10	1500 psi ± 50 psi	3-12 gpm
Complete unit replaced by 06-460-676						
* 06-460-656	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-24 gpm
* 06-460-658	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1850 psi ± 50 psi	3-24 gpm
* 06-460-660	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1150 psi ± 50 psi	3-24 gpm
* 06-460-662	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
* 06-460-664	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-12 gpm
* 06-460-666	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	950 psi ± 50 psi	3-24 gpm
06-460-668	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1000 psi ± 50 psi	3-12 gpm
* 06-460-670	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1550 psi ± 50 psi	3-8 gpm
06-460-672	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	750 psi ± 50 psi	3-24 gpm
* 06-460-674	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-12 gpm
06-460-676	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-12 gpm
06-460-678	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1700 psi ± 50 psi	3-24 gpm
* 06-460-680	1/2-20 UNF	SAE No. 8	SAE No. 8	SAE No. 10	1550 psi ± 50 psi	3-8 gpm
Complete unit replaced by 06-460-670						
06-460-682	1/2-20 UNF	SAE No. 8	SAE No. 8	SAE No. 10	750 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-672						
06-460-684	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1100 psi ± 50 psi	3-12 gpm
* 06-460-686	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1500 psi ± 50 psi	3-12 gpm
Complete unit replaced by 06-460-674						
06-461-520	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1850 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-461-658						
06-461-550	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-461-656						
06-461-610	9/16-18 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	950 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-461-666						
06-461-656	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-24 gpm
06-461-658	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1850 psi ± 50 psi	3-24 gpm
06-461-660	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1150 psi ± 50 psi	3-24 gpm
06-461-666	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	950 psi ± 50 psi	3-24 gpm
06-461-674	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-12 gpm

• For use with drum brakes (has residual check valve)

NOTE: The valves should be used within the flow capacities indicated above for optimum performance. Valves are functional at lower flows but response is reduced. At the higher flow operation higher pressure drops are seen.

OPEN CENTER HYDRAULIC BRAKE VALVE
PRIMARY CUP DESIGN
(Refer to Figure 10)

Disassembly

1. Remove boot (item 1) and pressure regulating spring assembly (item 2).

   CAUTION: Pressure regulating spring assembly has been set at the factory and should never be disassembled, re-adjusted or interchanged with another valve.

2. Separate end cap (item 21) from housing (item 11).

   CAUTION: Care must be taken as end cap is under tension of spring (item 19).

   Remove gasket (item 14).
3. Remove primary cup (item 17), retainer (item 18), spring (item 19) and residual valve (item 20) from end cap (item 21).
4. Remove cap screw (item 13) from under side of housing (item 11). Remove o-ring (item 12) from cap screw.
5. Remove retaining ring (item 8) from housing (item 11).
6. Remove sleeve (item 10) by pulling on push rod (item 4). Remove cup (item 9) from sleeve.
7. Remove piston (item 16) from housing (item 11). Remove piston ring (item 15) from piston.
8. Remove retaining ring (item 3) carefully with a small flat tool. Do not scratch bore of sleeve (item 10).
9. Remove push rod (item 4), spool (item 6) and spring (item 7) from sleeve (item 10). Remove cup (item 5) from spool (item 6).

Inspection

Clean and inspect all component parts for scratches, cracks or wear. Replace any parts that are excessively worn or damaged.

CAUTION: If spool (item 6), sleeve (item 10) or bore of housing (item 11) are in any way damaged, scratched or broken, the entire assembly must be replaced. These parts are select-fitted and are not interchangeable or replaceable with service items.

Assembly

1. Install new cup (item 9) on sleeve (item 10) and new cup (item 5) on spool (item 6).

   CAUTION: Lips on cups (items 5 & 9) should be away from ends of spool (item 6) and sleeve (item 10).

2. Place spring (item 7) in sleeve (item 10).
3. Install spool (item 6) in sleeve (item 10). Note direction of spool.
4. Install push rod (item 4) in sleeve (item 10) and secure it with new retaining ring (item 3).
5. Install new o-ring (item 12) on cap screw (item 13) and install in housing (item 11).
6. Carefully install sleeve (item 10) into housing (item 11).

   CAUTION: Make sure that groove on sleeve will engage cap screw (item 13).

   Install retaining ring (item 8).
7. Install new piston ring (item 15) on piston (item 16) and install in housing (item 11).
8. Place new residual valve (item 20), spring (item 19) and retainer (item 18) in end cap (item 21).

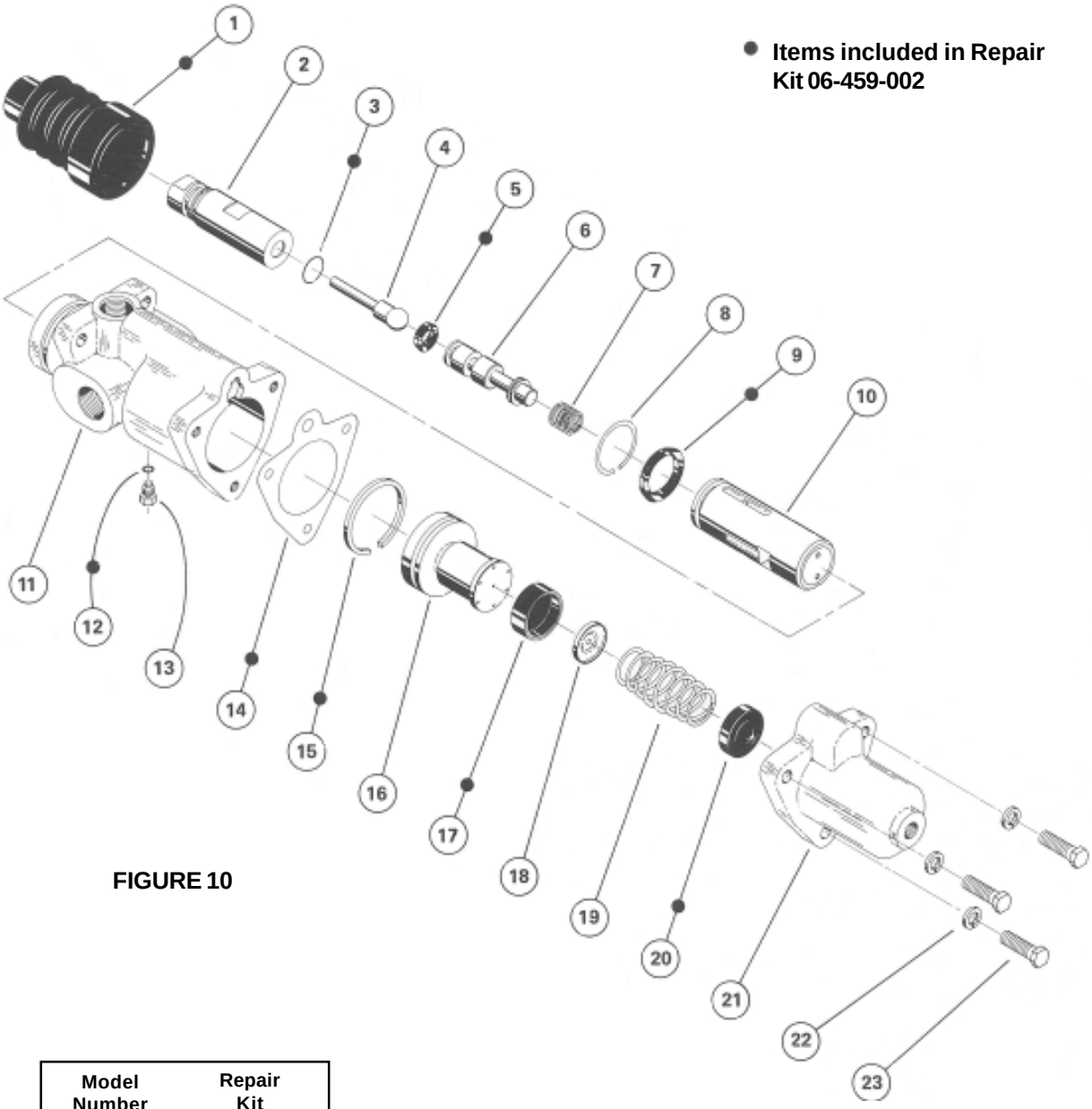
   CAUTION: Residual valve must be checked for proper seating in end cap.

9. Place new gasket (item 14) on mounting face of end cap (item 21) and new primary cup (item 17) on end of spring (item 19).
10. Assemble end cap (item 21) with its components to housing (item 11) making sure lip on primary cup (item 17) has properly engaged bore of housing.
11. Install lock washer (items 22) and bolts (items 23). Torque 16 to 18 ft. lbs.
12. Install pressure regulating spring assembly (item 2) on push rod (item 4). Install new boot (item 1).

SEE BLEEDING SECTION FOR COMPLETE BLEEDING INSTRUCTIONS

PARTS LIST

ITEM		DESCRIPTION
1	•	BOOT
2		PRESSURE REGULATING SPRING ASSEMBLY
3	•	RETAINING RING
4		PUSH ROD
5	•	CUP
6		SPOOL
7		SPRING
8		RETAINING RING
9	•	CUP
10		SLEEVE
11		HOUSING
12	•	O-RING
13		CAP SCREW
14	•	GASKET
15	•	PISTON RING
16		PISTON
17	•	PRIMARY CUP
18		RETAINER
19		SPRING
20	•	RESIDUAL VALVE
21		END CAP
22		LOCKWASHERS
23		BOLTS



● **Items included in Repair Kit 06-459-002**

FIGURE 10

Model Number	Repair Kit
06-460-520	06-459-002
06-460-522	06-459-002
06-460-550	06-459-002
06-460-560	06-459-002
06-460-570	06-459-002
06-460-580	06-459-002
06-460-588	06-459-002
06-460-610	06-459-002
06-460-620	06-459-002
06-460-650	06-459-002
06-460-680	06-459-002
06-460-686	06-459-002

OPEN CENTER HYDRAULIC BRAKE VALVE
RING SEAL DESIGN
(Refer to Figure 11)

Disassembly

1. Remove boot (item 1) and pressure regulating spring assembly (item 2).

   CAUTION: Pressure regulating spring assembly has been set at the factory and should never be disassembled.

2. Separate end cap (item 21) from housing (item 11).

   CAUTION: Care must be taken as end cap is under tension of spring (item 20).

   Remove gasket (item 14).

3. Remove piston & poppet assembly (item 17) and spring (item 20) from end cap (item 22).

   CAUTION: If you have model 06-460-566, you will also have to remove residual valve (item 21).

4. Remove cap screw (item 13) from under side of housing (item 11). Remove o-ring (item 12) from cap screw.
5. Remove retaining ring (item 8) from housing (item 11).
6. Remove sleeve (item 10) by pulling on push rod (item 4). Remove cup (item 9) from sleeve.
7. Remove piston (item 16) from housing (item 11). Remove piston ring (item 15) from piston.
8. Remove retaining ring (item 3) carefully with a small flat tool. Do not scratch bore of sleeve (item 10).
9. Remove push rod (item 4), spool (item 6) and spring (item 7) from sleeve (item 10). Remove cup (item 5) from spool (item 6).

Inspection

Clean and inspect all component parts for scratches, cracks or wear. Replace any parts that are excessively worn or damaged.

CAUTION: If spool (item 6), sleeve (item 10) or bore of housing (item 11) are in any way damaged, scratched or broken, the entire assembly must be replaced. These parts are select-fitted and are not interchangeable or replaceable with service items.

Assembly

1. Install new cup (item 9) on sleeve (item 10) and new cup (item 5) on spool (item 6).

   CAUTION: Lips on cups (items 5 & 9) should be away from ends of spool (item 6) and sleeve (item 10).

2. Place spring (item 7) in sleeve (item 10).
3. Install spool (item 6) in sleeve (item 10). Note direction of spool.
4. Install push rod (item 4) in sleeve (item 10) and secure it with retaining ring (item 3).
5. Install new o-ring (item 12) on cap screw (item 13) and install in housing (item 11).
6. Carefully install sleeve (item 10) into housing (item 11).

   CAUTION: Make sure that groove on sleeve will engage cap screw (item 13)

   Install retaining ring (item 8).

7. Install piston ring (item 15) on piston (item 16) and install in housing (item 11).
8. Install new o-ring (item 18) and new ring seal (item 19) on new piston & poppet assembly (item 17).
9. Install spring (item 20) and piston & poppet assembly (item 17) in end cap (item 22).

   NOTE: If you have model 06-460-566, you will have to install new residual valve (item 21). You must also check residual valve for proper seating in end cap.

CAUTION: Extreme care must be taken so as not to scratch teflon seal (item 19) when installing piston & poppet assembly (item 17) in end cap (item 22).

10. Place new gasket (item 14) on mounting face of end cap (item 22) and assemble, with its components, to housing (item 11).
11. Install lock washers (item 23) and bolts (item 24). Torque 16 to 18 ft. lbs.
12. Install pressure regulating spring assembly (item 2) on push rod (item 4). Install new boot (item 1).

SEE BLEEDING SECTION FOR COMPLETE BLEEDING INSTRUCTIONS

PARTS LIST

ITEM	DESCRIPTION
1 * •	BOOT
2	PRESSURE REGULATING SPRING ASSEMBLY
3	RETAINING RING
4	PUSH ROD
5 * •	CUP
6	SPOOL
7	SPRING
8	RETAINING RING
9 * •	CUP
10	SLEEVE
11	HOUSING
12 * •	O-RING
13	CAP SCREW
14 * •	GASKET
15 *	PISTON RING
16	PISTON
17 * •	PISTON & POPPET ASSEMBLY
18 * •	O-RING
19 * •	RING SEAL
20	SPRING
21 *	RESIDUAL VALVE
22	END CAP
23	LOCKWASHERS
24	BOLTS

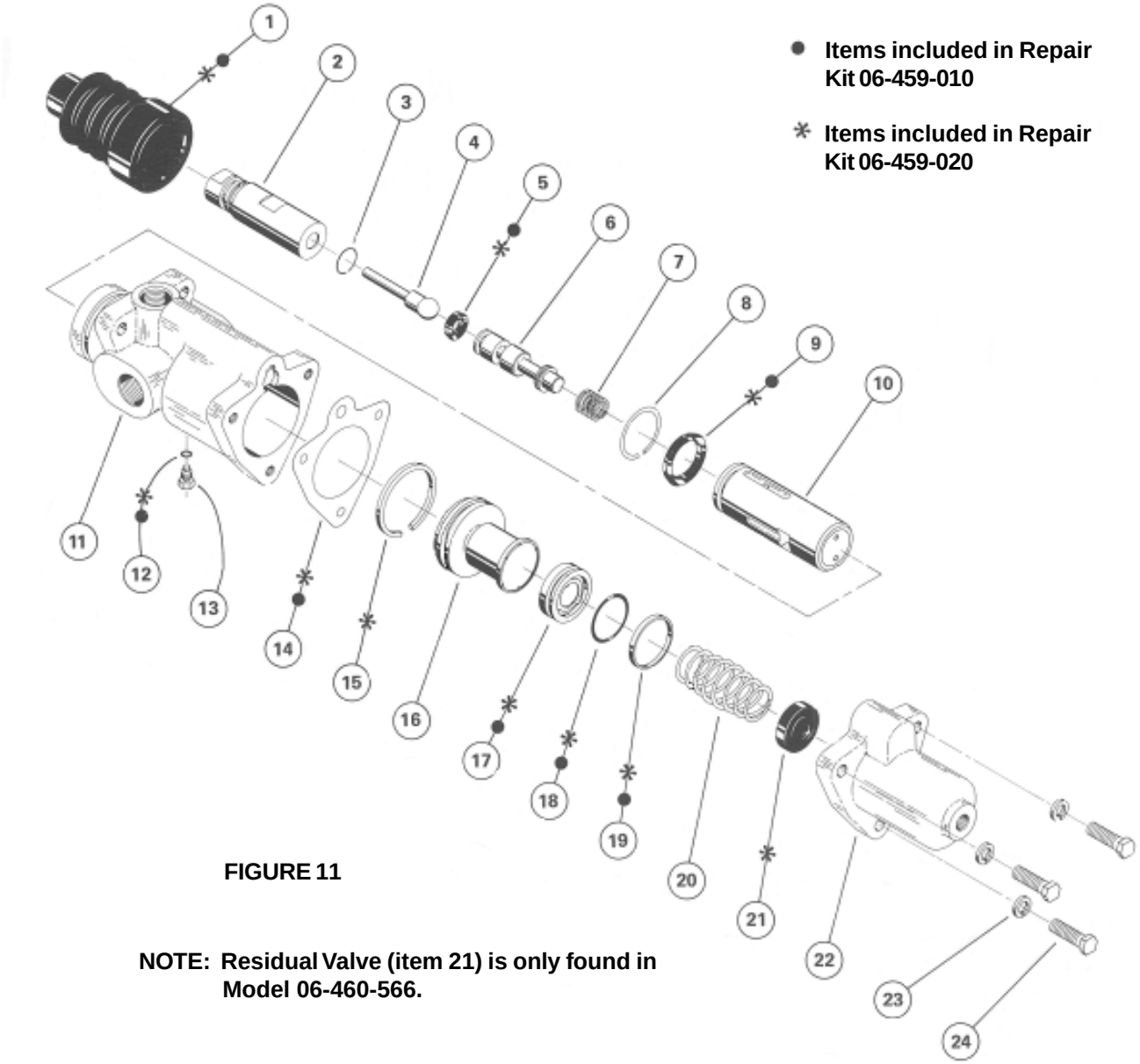


FIGURE 11

NOTE: Residual Valve (item 21) is only found in Model 06-460-566.

Model Number	Repair Kit
06-460-654	06-459-010
06-460-656	06-459-020
06-460-658	06-459-020
06-460-660	06-459-020
06-460-662	06-459-020
06-460-664	06-459-020
06-460-666	06-459-020
06-460-668	06-459-010
06-460-670	06-459-020
06-460-672	06-459-010
06-460-674	06-459-020
06-460-676	06-459-010
06-460-678	06-459-020
06-460-682	06-459-010

OPEN CENTER HYDRAULIC BRAKE VALVE
SLIDING PISTON DESIGN
(Refer to Figure 12)

Disassembly

1. Remove boot (item 1) and pressure regulating spring assembly (item 2).

   CAUTION: Pressure regulating spring assembly has been set at the factory and should never be disassembled.

2. Separate end cap (item 20) from housing (item 3).

   CAUTION: Care must be taken as end cap is under tension of spring (item 18).

   Remove gasket (item 6).
3. Remove piston & poppet assembly (item 15), spring (item 18) and residual valve (item 19) from end cap (item 20).
4. Remove cap screw (item 5) from under side of housing (item 3). Remove o-ring (item 4) from cap screw.
5. Remove sleeve & piston assembly (item 14) from housing (item 3). Remove cup (item 12) and piston ring (item 13) from sleeve & piston assembly (item 14).
6. Remove retaining ring (item 7) carefully with a small flat tool. Do not scratch bore of sleeve & piston assembly (item 14).
7. Remove push rod (item 8), spool (item 10) and spring (item 11) from sleeve & piston assembly (item 14). Remove cup (item 9) from spool (item 10).

Inspection

Clean and inspect all component parts for scratches, cracks or wear. Replace any parts that are excessively worn or damaged.

CAUTION: If spool (item 10), sleeve (item 14) or bore of housing (item 3) are in any way damaged, scratched or broken, the entire assembly must be replaced. These parts are select-fitted and are not interchangeable or replaceable with service items.

Assembly

1. Install new cup (item 12) and new piston ring (item 13) on sleeve & piston assembly (item 14).

   CAUTION: Lips on cup (item 12) should be away from end of sleeve (item 14).

2. Install new cup (item 9) on spool (item 10).

   CAUTION: Lips on cup (item 9) should be away from end of spool (item 10).

3. Insert spool (item 10) and push rod (item 8) into sleeve & piston assembly (item 14). Secure with retaining ring (item 7).
4. Carefully install sleeve & piston assembly (item 14) into housing (item 3).

   CAUTION: Make sure that groove on sleeve will engage screw (item 5).

5. Install new o-ring (item 4) on cap screw (item 5) and install in housing (item 3).
6. Install new o-ring (item 16) and new ring seal (item 17) on new piston & poppet assembly (item 15).
7. Place residual valve (item 19), spring (item 18) and piston & poppet assembly (item 15) in end cap (item 20).

   NOTE: Residual valve must be checked for proper seating in end cap.

CAUTION: Extreme care must be taken so as not to scratch ring seal (item 17) when installing piston & poppet assembly (item 15) in end cap (item 20).

8. Place new gasket (item 6) on mounting face of end cap (item 20) and assembly, with its components, to housing (item 3).
9. Install lock washers (items 21) and bolts (items 22). Torque 16 to 18 ft. lbs.
10. Install pressure regulating spring assembly (item 2) on push rod (item 8). Install new boot (item 1).

SEE BLEEDING SECTION FOR COMPLETE BLEEDING INSTRUCTIONS

PARTS LIST

ITEM		DESCRIPTION
1	•	BOOT
2		PRESSURE REGULATING SPRING ASSEMBLY
3		HOUSING
4	•	O-RING
5		CAP SCREW
6	•	GASKET
7		RETAINING RING
8		PUSH ROD
9	•	CUP
10		SPOOL
11		SPRING
12	•	CUP
13	•	PISTON RING
14		SLEEVE & PISTON ASSEMBLY
15	•	PISTON & POPPET ASSEMBLY
16	•	O-RING
17	•	RING SEAL
18		SPRING
19	•	RESIDUAL VALVE
20		END CAP
21		LOCKWASHERS
22		BOLTS

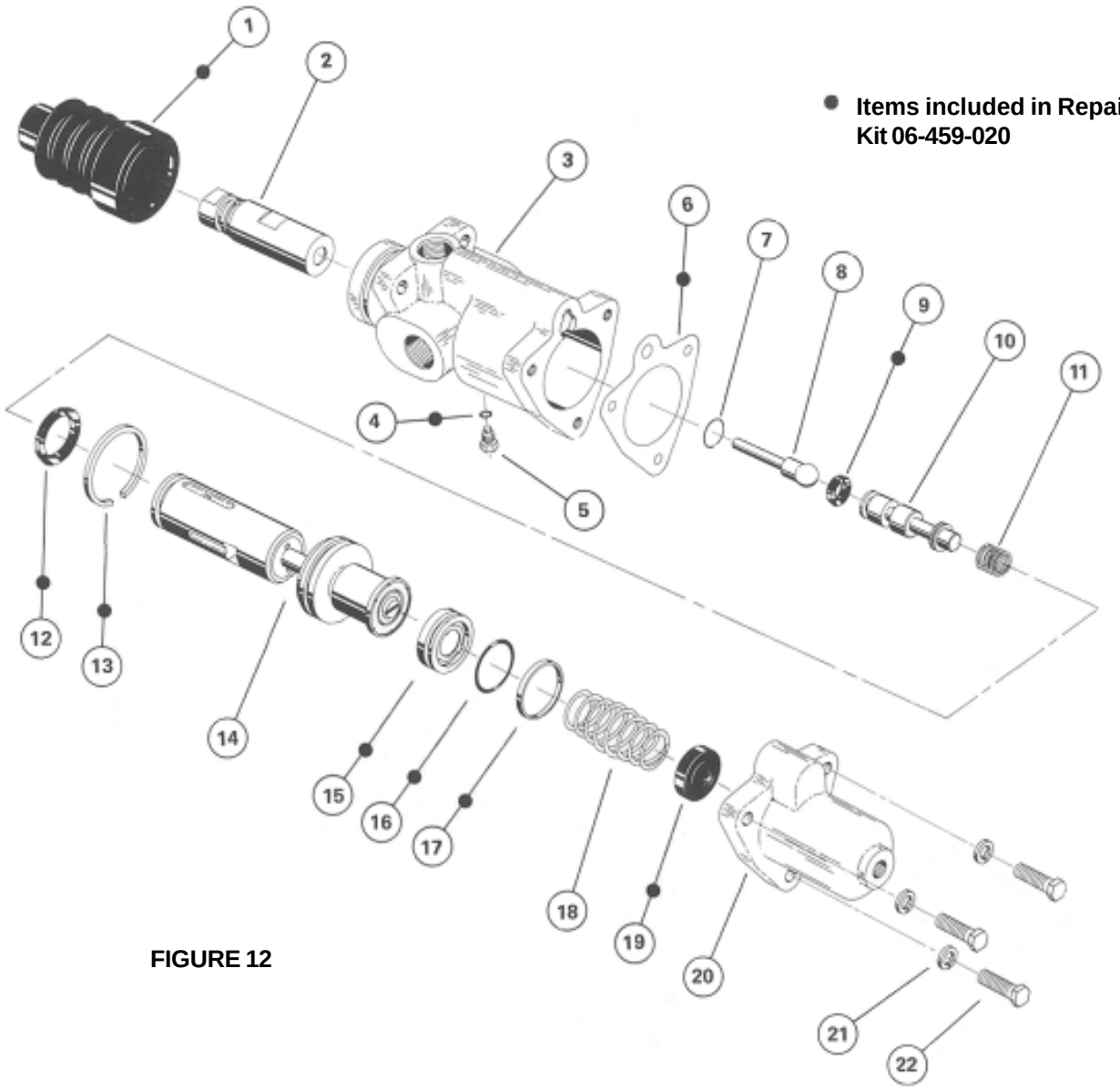


FIGURE 12

Model Number	Repair Kit
06-460-642	06-459-020
06-460-684	06-459-020

GENERAL SERVICE DIAGNOSIS

With Engine Off --

PEDAL GOES TO FLOOR

1. Brake not adjusted
1. **Check adjustment**
2. Air in system
2. **Bleed brakes**
3. Inoperative brakes
3. **Check brakes**
4. Blown hydraulic line
4. **Check brake line**
5. Worn out primary cup
5. **Check by making sure brakes are properly adjusted, in good operating condition, and system well bled. If pedal continues to go to the floor, service brake valve.**

SPONGY PEDAL

1. Air in system
1. **Bleed brakes**

PEDAL IS FIRM BUT STOPS TOO NEAR FLOOR

1. Brakes out of adjustment
1. **Adjust brakes**
2. Inoperative brakes
2. **Check for wear**
3. Displacement problem
3. **Wheel cylinders too large for valve to handle properly. Consider alternate braking valve.**

PEDAL IS FIRM BUT BRAKING IS INADEQUATE TO STOP VEHICLE IN EVENT OF ENGINE FAILURE

1. Pedal ratio too small
1. **Increase pedal ratio**
2. Brakes inoperative
2. **Check brakes for wear or oily brakes**
3. Brakes not adjusted
3. **Check adjustment**
4. Air in system
4. **Bleed system**

NO POWER STEERING OR OTHER DOWNSTREAM HYDRAULIC ACTION AT ANY TIME

1. Hydraulic lines crossed
1. **Recheck circuit**
2. No hydraulic action at any time
2. **Check and fill reservoir. Check relief valve setting on pump. Check for proper rotation at pump, vee belt, sheared keys, etc.**

With Engine Running --

PEDAL GOES DOWN PART WAY THEN BOUNCES BACK

1. Insufficient flow from pump
1. **Check and fill reservoir**
2. Small volume from pump at idle
2. **Crack throttle and recheck**

NO OR SLOW POWER STEERING WITH BRAKES APPLIED

1. Recheck relief valve on pump for proper setting
2. Check and fill reservoir
3. Check and tighten pump belt if necessary

BLEEDING

The MICO Open Center Power Brake Valve and remaining brake system are sometimes difficult to bleed. The difficulty arises when the hydraulic oil used does not flow easily through lines and small holes by means of gravity. Generally, to effectively remove air, oil must be forced into the brake valve master cylinder cavity and the rest of the system.

CAUTION: Make sure the machine is in a safe and controlled state before attempting any servicing including bleeding the brake system.

Manual and pressure bleeding are two methods of bleeding a brake system. MICO recommends using one of these two methods of bleeding the Open Center Power Brake Valve and the rest of the brake system.

CAUTION: Be sure brake valve is installed properly and brakes adjusted correctly before beginning bleeding procedures.

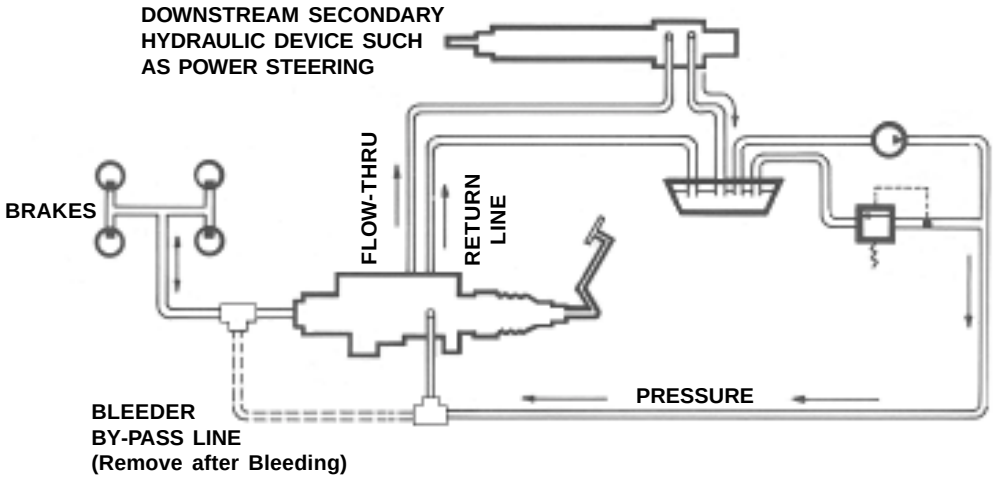
MANUAL BLEEDING PROCEDURES

1. Start engine and allow enough time to pass for the system to become filled and thoroughly flushed with oil.
2. With engine still running, one person can stroke the brake pedal while another person opens and closes the brake bleeder screws.
3. Only on the down stroke of the brake pedal, open bleeder screw on the brake closest to brake valve first. When all flow stops from bleeder, close it and allow pedal to return to rest.
4. Wait at least 30 seconds and repeat the process until all air has been expelled from that brake. Then go on to the next closest brake bleeder and repeat process until all brakes have been bled.
5. Stop engine and depress brake pedal. Pedal should be hard, not spongy, and fairly high. If pedal is too spongy and/or travels too far, repeat bleeding process.
6. It is a characteristic of the brake valve to kick the pedal back when actuated if system is not bled with engine running.

PRESSURE BLEEDING PROCEDURE

1. Refer to Figure 13. Install a small BLEEDER BY-PASS LINE as shown. A 1/4" size line or hose is sufficient.
2. Start engine and allow enough time to pass for the system to become filled and thoroughly flushed with oil.
3. It is necessary to develop between 50-200 PSI at the inlet to brake valve. A method to throttle the oil will be needed if the system does not already have a secondary hydraulic device downstream from the brake valve. THIS PRESSURE SHOULD BE HELD THROUGHOUT THE BLEEDING PROCESS AND SHOULD NOT EXCEED 250 PSI.
4. DO NOT STEP ON THE BRAKE PEDAL DURING THIS BLEEDING PROCESS.
5. Oil will now be forced directly into the brake line by the pump and fill the brake valve master cylinder cavity. This may take a minute or two.
6. Continue to hold the bleed pressure while bleeding each brake starting with the line and brake closest to the brake valve.
7. Allow a sufficient amount of fluid to pass at brake bleeder screw to insure all air is removed from each bleeder point.
8. Continue this method until all brakes and lines are bled.
9. When all brakes are bled and fittings tight, release the 50-200 PSI pressure and SHUT OFF ENGINE.
10. Remove the bleeder by-pass line and plug the connections. Be sure not to lose fluid or ingest air at the brake line connection when removing bleeder by-pass line.
11. With engine off, step on brake pedal. It should be fairly high and hard. If a spongy pedal is felt, the system still contains air. If pedal strokes downward too far, check and readjust brakes and repeat bleeding process.
12. When the pedal is satisfactory, restart engine and actuate brake pedal several times. Now check for leaks.

FIGURE 13



BLEEDING SCHEMATIC

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